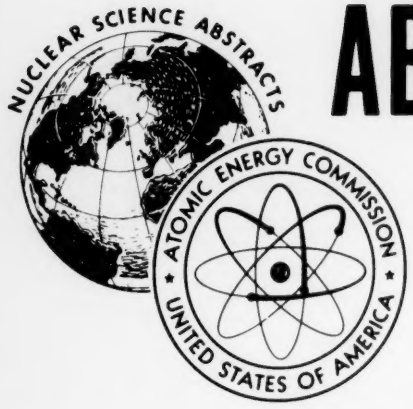
NUCLEAR SCIENCE ABSTRACTS



Volume 28 Number 10

Abstracts 24075-26953

November 30, 1973

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NUCLEAR SCIENCE ABSTRACTS

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ACETONE/RADIOLYSIS
  Pulse radiolysis of alkyl ketones, 27:24388
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21102 (ORNL-4846) GAMMA-RAY PRODUCTION DUE TO NEUTRON INTERACTIONS WITH COPPER FOR INCIDENT NEUTRON ENERGIES BETWEEN 1.0 AND 20 MeV: TABULATED DIFFERENTIAL CROSS SECTIONS. Dickens, J. K.; Love, T. A.; Morgan, G. L. **(Oak Ridge National Lab., Tenn).** Feb 1973. Contract W-7405-eng-26. 44p. Dep. NTIS $4.00.

is indexed as:

OAK RIDGE NATIONAL LAB., TENN.
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Information on the availability of the published literature and unpublished conference papers abstracted in *Nuclear Science Abstracts* can be obtained from the USAEC Technical Information Center, P. O. Box 62, Oak Ridge, Tennessee 37830.

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NUCLEAR SCIENCE ABSTRACTS

CHEMISTRY

Analytical and Separations Chemistry

Refer also to abstracts 25273 and 26935.

24075 ANALYTICAL CHEMISTRY OF NEPTUNIUM. Mikhailov, V. A. Analytical Chemistry of the Elements. New York; John Wiley and Sons, Inc. (1973). 241p. $24.00.

Translated by R. Kondor.

Topics considered in the monograph are: general information on neptunium; chemical–analytical characteristics of neptunium and its compounds; methods for separating neptunium from foreign elements (precipitation, electrodeposition, extraction, and chromatography); quantitative determination of neptunium (radiometric, spectrophotometric, radioactivation, titrimetric, and electrochemical methods); determination of neptunium in various materials; and analysis of neptunium for impurities. (DHM)

24076 ANALYTICAL CHEMISTRY OF SELENIUM AND TELLURIUM. Nazarenko, I. I.; Ermakov, A. N. Analytical Chemistry of the Elements. New York; John Wiley and Sons, Inc. (1972). 290p.

Translated by R. Kondor.

Topics considered in the monograph are: general information on properties of Te and Se and their compounds; chemical and analytical characteristics; qualitative detection of Se and Te; quantitative determination of Se and Te gravimetric, titration, photometric, fluorometric, catalytic, electrochemical, spectral, flame photometric, atomic absorption, x-ray fluorescence, and radioactivation methods); methods for separating Se and Te from foreign elements; determination of Se and Te in natural and industrial substances; and determination of impurities in high-purity Se and Te. (DHM)

24077 PROCEEDINGS OF THE 18th ANNUAL ISA ANALYSIS INSTRUMENTATION SYMPOSIUM, SAN FRANCISCO, CALIFORNIA, MAY 3–5, 1972. Chapman, R. L.; McNeill, G. A.; Bartz, A. M. (ed.). Analysis Instrumentation, Vol. 10. Pittsburgh; Instrument Society of America (1972). 260p. (CONF-720596-).

Thirty-two papers encompassing the topics: instrumentation and methods of analysis (chemical, electrochemical, chromatography, radiation); sampling and calibration systems; industrial process applications; air and water quality applications; and computer systems for on-line analysis, are included in the bound proceedings. Three additional papers that were presented at the conference are included as an appendix. Separate abstracts were prepared for the four papers within the NSA scope. (DHM)

For abstracts of individual papers see: 24166, 24167, 24532, and 24592.

24078 PRESENT STATUS OF METHODS OF SEPARATING AND DETERMINING THE NOBLE METALS. Beamish, F. E.; Van Loon, J. C. (Univ. of Toronto). Miner. Sci. Eng.; 4: No. 4, 3-17(1972).

This review of methods of separation and determination of Pd, Pt, Au, Rh, Ru, Os, and Ir records the authors' opinions of the present status of these methods. The quantitative techniques described are atomic absorption, neutron activation, spectrochemistry, X-ray fluorescence, polarography, spectrophotometry, gravimetry and titrimetry. (103 references.) (Anal. Abstr.)

Activation and Nuclear Reaction Procedures

Refer also to abstracts 24255, 24644, 25013, 25322, and 26094.

24079 (CONF-721069–26) TRACE ANALYSIS IN SOLID SUBSTANCES USING ION BEAMS. Deconninck, G. (Facultes Universitaires Notre-Dame de la Paix, Namur (Belgium)). 1972. 11p. (In French). Dep. NTIS (U. S. Sales Only) $3.00.

From International colloquium on the activation analysis of micro-quantities of elements in very high-purity inorganic and organic substances and in biological media; Saclay, France (2 Oct 1972).

Solid substances were bombarded with protons and alpha particles in view of analyzing traces of foreign materials. Prompt analysis methods were used, i.e., the radiation emitted during the bombardment of the sample (γ or x rays and backscattered α particles). The following problems are presented: analysis of the surface of glass (determination of B and Sn); analysis of teeth (determination of Ca and F); analysis of iron in silica gels and Xerogels; analysis of atmospheric pollution filters; analysis of heavy elements (Rb, Hg) in plant samples. (Fr)

24080 (NIM-1503) FAST-NEUTRON-ACTIVATION ANALYSIS FOR THE DETERMINATION OF OXYGEN IN ROCK SAMPLES. Bibby, D. M. (National Inst. for Metallurgy, Johannesburg (South Africa)). 16 May 1973. 28p. Dep. NTIS (U. S. Sales Only) $3.50.

The problems associated with fast-neutron activation analysis for oxygen are considered in detail, and a method is described for the determination of oxygen in rocks. The oxygen contents of a number of international rock standards were measured with a precision of less than 0.3%. The potential uses of oxygen analyses with this precision are discussed briefly, and possible improvements are suggested. (auth)

24081 (UCLA-12-919, pp 53-54) CHEMICAL PROBLEMS. 1973.

In annual progress report for the period ending June 30, 1973.

24082 SIMPLE PROGRAM FOR WEIGHTED LINEAR REGRESSION APPLIED TO ACTIVATION ANALYSIS DATA PROCESSING. Taczanowski, S. (Inst. of Nuclear Techniques, Krakow). J. Radioanal. Chem.; 13: No. 2, 475-482(Feb 1973).

A simple ALGOL program for activation analysis data handling is presented. The program, although designed in principle for processing single-channel spectrometry data, may also be used for multichannel spectrometry, on condition that the peak area is computed separately. The calculations of instrumental error and standard deviation are carried out. The outliers are tested, and the regression line diagram with the related observations are plotted by the program. (auth)

24083 DETERMINATION OF NICKEL IN AIR DUST BY NEUTRON ACTIVATION ANALYSIS. Das, H. A.; Evendijk, J. E.; de Jong, J. P. M. (Reactor Centre, Petten, Netherlands). J. Radioanal. Chem.; 13: No. 2, 413-418(Feb 1973).

The determination of nickel in atmospheric aerosols, collected on filter paper, was performed by thermal neutron activation analysis using the ^{65}Ni (T = 2.56 h) isotope. Liquid–liquid extraction and anion-exchange are applied in the chemical separation. The absolute sensitivity of the method is ≈0.02 μg Ni. The relative sensitivity is 0.005 μg Ni/m^3 if an air sample of about 1000 m^3 is used. (auth)

24084 NEUTRON ACTIVATION ANALYSIS OF IODINE IN BLOOD SERUM OR OTHER BIOLOGICAL MATERIALS BY SUBSTOICHIOMETRIC PRECIPITATION OF IODINE AS SILVER IODIDE. Cornelis, R.; Hoste, J. (Univ., Ghent). J. Radioanal. Chem.; 13: No. 2, 419-426(Feb 1973).

Several modifications are proposed of the established methods of iodine determination in serum. Prior to the actual analysis, the serum is lyophilized. This preliminary treatment permits the use of large samples. Through lyophilization human blood serum samples can easily be reduced to one-tenth of the original weight. Reduction is even more dramatic with materials from other than human origin. After irradiation the samples are subjected to chemical treatment in the presence of an iodine carrier and ^{131}I-labelled thyoxine. This procedure has been adopted for the determination of the iodine content and the chemical yield in one and the same radioactive measurement. The analysis technique itself consists of an open system Schoeniger combustion. The open combustion allows the use of large samples; the gases evolved are absorbed upon their subsequent passage through potassium hydroxide and hydrochloric acid; the mineralization requires less than two minutes. After the addition of a substoichiometric amount of silver nitrate, silver iodide is precipitated from an ammoniacal solution as a flat sample, which has been found ideally suited for high efficiency counting with a Ge(Li) detector. The spectrum gives evidence of an excellent decontamination from the ^{38}Cl, ^{80}Br, and ^{82}Br activities. The iodine content can be calculated from the ratio of the photopeak areas at 364.5 keV and 442.7 keV corresponding to ^{131}I and ^{128}I, respectively. The chemical procedure requires a mere 15 min, and the recording of the γ spectrum takes no longer than 30 min. The technique is not limited to serum only. It proved well suited for the analysis of many other types of biological material, e.g., human skin tissues. (auth)

24085 MONOSTANDARD ACTIVATION ANALYSIS AND ITS APPLICATIONS: ANALYSES OF KALE POWDER AND NBS STANDARD GLASS SAMPLES. Kim, J. I.; Born, H. J. (Technische Universitaet Munich, Garching, Ger.). Radioanal. Chem.; 13: No. 2, 427-442(Feb 1973).

The monostandard method with the use of Ge(Li) γ spectrometry was elaborated with a critical evaluation of the nuclear data involved in activation and activity measurement. The method was tested by analyzing simultaneously 15 elements in a well known standard material of Kale powder and 12 elements in NBS standard glass samples. The results are compared with the reported data to prove the accuracy of the monostandard method. (auth)

24086 DETERMINATION OF INORGANIC IMPURITIES IN PVC LATEX BY ACTIVATION ANALYSIS. Bunus, F. (Inst. of Atomic Physics, Bucharest). J. Radioanal. Chem.; 13: No. 2, 443-449(Feb 1973).

Experimental work was carried out in order to determine inorganic impurities in PVC latex by activation analysis. Arsenic and bromine were detected and quantitatively determined by means of two alternative methods: (a) comparison of the samples and As_2O_3 and KBr standards simultaneously irradiated with slow neutrons; (b) the same as (a), but considering only bromine and using standards made by adding and homogenizing known amounts of KBr in the PVC latex. All measurements were based on γ spectrometry. The mean values given by method (a) are: arsenic $(2.5 \pm 0.4) \times 10^{-4}$%, bromine $(1.9 \pm 0.1) \times 10^{-3}$%. In method (b) the bromine found was $(2.47 \pm 0.03) \times 10^{-3}$%. (auth)

24087 CHERENKOV DETECTORS FOR OXYGEN DETERMINATION WITH FAST REACTOR NEUTRONS. Lueck, H. B.; Rommel, H. (Zentralinstitut fuer Kernforschung, Rossendorf, Ger.). J. Radioanal. Chem.; 13: No. 2, 451-457(Feb 1973). (In German).

Three variants of oxygen determination differing in their programs of activation and measuring are presented. The high energetic β radiation of ^{16}N produced by ^{16}O(n,p)^{16}N was detected by a Cherenkov-counter with scintillator of Piacryl (Lucite). Standard deviation and sensitivity of the three variants were investigated. Sensitivity in interference free samples amounts to 4,000 counts/mg of oxygen and the threshold of detection to 10 μg of oxygen. If the contents of oxygen is more than 1 mg, the standard deviation will be 1.25%. (auth)

24088 ON-STREAM NUCLEAR ACTIVATION OF TRACE URANIUM AND THORIUM USING A 14-MEV NEUTRON GENERATOR. Al-Shahristani, H. (Nuclear Research Inst., Baghdad); Jervis, R. E. J. Radioanal. Chem.; 13: No. 2, 459-468(Feb 1973).

A method for the continuous on-stream determination of trace concentrations of uranium and thorium in flowing streams is developed. The 14 MeV neutron generator was used for irradiation and the delayed neutron counting technique was employed in counting the induced neutron activity. The dependence of the minimum detectable concentration on the irradiation, decay and counting times, liquid flow-rate, and the background was studied. At optimal conditions, uranium and thorium concentrations were determined down to 20 and 100 ppM, respectively. The interference of the neutron emitting nuclide ^{17m}O was reduced to an insignificant level by optimizing the decay time. (auth)

24089 APPLICATION OF NEUTRON ACTIVATION ANALYSIS TO THE DETERMINATION OF TRACE ELEMENTS IN POLLEN AND SPOROPOLLENINS. Fawcett, P.; Green, D.; Shaw, G. (Univ. of Bradford, Eng.). J. Radioanal. Chem.; 13: No. 2, 313-318(Feb 1973).

Neutron activation analysis was used to assay the trace elements Co, Fe, Sc, Rb, and Zn in pollen and derived sporopollenins. The method is capable of high precision and avoids the necessity for sample ashing and the introduction of reagent contamination. Rubidium was completely removed during the chemical isolation of sporopollenins and the remaining elements which survived chemical treatment were found in reduced amounts. The ratio of Sc : Fe in pollen and in several derived sporopollenins was found to be approximately constant. Results are discussed with reference to the possibilities of anomalous chemical behavior of the elements resulting from irradiation. (auth)

24090 RADIOACTIVATION ANALYSIS OF ALUMINUM, VANADIUM, COPPER, MOLYBDENUM, ZINC, AND URANIUM IN NATURAL WATER SAMPLES USING ORGANIC COPRECIPITANTS. Fujinaga, T. (Kyoto Univ.); Kusaka, Y.; Koyama, M.; Tsuji, H.; Mitsuji, T.; Imai, S.; Okuda, J.; Takamatsu, T.; Ozaki, T. J. Radioanal. Chem.; 13: No. 2, 301-311(Feb 1973).

A method is described for the determination of trace metal ions, V, Al, Cu, Mo, An, and U, in natural water samples by neutron activation analysis, using organic coprecipitation as a preconcentration method. The preconcentration of trace elements was accomplished by converting the dissolved trace metal ions into the oxine chelates at pH 5.2 and extraction of the chelates with o-phenylphenol which is a liquid above 56°C and solidifies at room temperature. After cooling the extraction system, the fine particles of the organic phase were collected on a millipore filter and the precipitate was air-dried in a clean environment. The solid extract was wrapped up in a sheet of clean polyethylene and subjected to neutron irradiation in a reactor for less than 10 min at a thermal flux of $2 \cdot 10^{13}$ n $\cdot$ cm$^{-2} \cdot$ sec^{-1}. Gamma spectrometry by a coaxial Ge(Li) detector connected to a 1024-channel PHA was performed on the irradiated sample without further chemical separation, and thus the ppB level concentration of the elements in natural water samples could be determined. The fundamental study of the collection of the trace elements is also described. (auth)

24091 RETENTION OF RADIOCOPPER ON CUPROUS THIOCYANATE FOR ACTIVATION ANALYSIS. Csajka, M. (Central Research Inst. for Physics, Budapest). J. Radioanal. Chem.; 13: No. 2, 329-333(Feb 1973).

Ninety-eight per cent recovery of radioactive copper ions from solution was achieved by retention on cuprous thiocyanate precipitates. The copper uptake was determined under different experimental conditions by varying the contact time, the concentration of other ionic species in the solution, etc. The method was utilized in the activation analysis of copper in metallic nickel and iron meteorites. (auth)

24092 MEASUREMENT OF CARBON DIFFUSION PROFILES BY MEANS OF THE NUCLEAR MICROPROBE. Pierce, T. B.; McMillan, J. W.; Peck, P. F.; Jones, I. G. (Atomic Energy Research Establishment, Harwell, Eng.). Radiochem. Radioanal. Lett.; 14: No. 5-6, 357-363(5 Sep 1973).

A charged particle microbeam method was developed for the measurement of carbon distributions through thin steel specimens. The technique is based on the ^{12}C(d,p)^{13}C reaction; the microbeam is scanned, in steps across an edge section of the specimen and the proton yield measured at each point. The proton yield is interpreted in terms of carbon percentage by means of a calibration curve constructed after irradiation of steels of known carbon content. The spatial resolution of the method is about 10 micrometers and carbon concentration down to 500 ppM can be measured readily. (auth)

24093 INSTRUMENTAL ACTIVATION DETERMINATION OF TRACE AMOUNTS OF COPPER. Miranskii, I. A.; Ramazanov, R. Sh. At. Energ. (USSR); 33: No. 3, 772-773(Sep 1972). (In Russian).

This paper was summarized as paper No. 608/6558 with full copy held by TIC.

Copper determinations in rocks and ores on the basis of the annihilation radiation of the ^{64}Cu isotope involves difficulties due to the presence of ^{24}Na; the interaction between the hard γ radiation of ^{24}Na and the surrounding host materials can also lead to annihilation radiation interfering with the determination. When a total-coincidence spectrometer is employed, it becomes possible to make successful copper determinations even when the sodium content is three whole orders of magnitude greater than the copper content. Previously reported investigations have shown that the optimum weighed portion of rock for an analysis must weigh 50 mg, the weight of the standard must be 10^{-5} g, the irradiation time 3 to

4 min in a thermal column with a flux of $1.2 \cdot 10^{12}$ neutrons/cm^2 · sec, exposure time 12 h, measurement time 15 min, and the spectrometer loading must not be in excess of 3×10^3 to 4×10^3 pulses/sec. These parameters were observed in determining copper in rock and ore samples with a sensitivity of 10^{-3}% with satisfactory reliability, and with sensitivity of 10^{-4}% in the case of specimens reported in the literature. The data were monitored by radiochemical methods. Excellent agreement was found in the results. (auth)

24094 DETERMINATION OF WHOLE BODY MAGNESIUM BY IN VIVO NEUTRON ACTIVATION. Dombrowski, C. S.; Wallach, S.; Shukla, K. K.; Cohn, S. H. (Brookhaven National Lab., Upton, NY). Int. J. Nucl. Med. Biol.; 1: No. 1, 15-21(Jan 1973).

In vivo studies utilizing ^{28}Mg provide an incomplete description of the effects of endocrine and metabolic factors on Mg homeostasis and conservation since most body Mg does not exchange with the injected radioisotope. Neutron activation analysis has been found to be a feasible technique for in vivo determinations of total body calcium, sodium, chlorine, iodine, nitrogen, and phosphorus in man and animals. The 11 percent of body Mg which exists as ^{26}Mg is capable of being transmuted by thermal neutron irradiation to ^{27}Mg [^{26}Mg(n,γ)^{27}Mg], a radionuclide which emits gamma rays at 0.84 and 1.01 MeV with a half-life of 9.5 min. Studies of the thermal neutron beam from the Brookhaven Medical Research Reactor indicate a variation in depth flux density of ±4.0 per cent across a rat phantom when it is irradiated rotationally in a specially designed holder apparatus. The induced gamma ray activity from ^{27}Mg is linearly related to the total Mg content of the rat phantom over the range 50 to 500 mg. The gamma ray activity is measured with a 25 cm^3 Ge(Li) semiconductor detector and both the 0.84 and the 1.01 MeV emissions are measured. The technique is nondestructive and multiple determinations of whole body Mg in the same rat are possible. Absolute values for body Mg content may be attainable by the use of appropriate phantoms. (auth)

24095 DETERMINATION OF MERCURY AND SELENIUM IN COAL BY NEUTRON ACTIVATION ANALYSIS. Weaver, J. N. (North Carolina State Univ., Raleigh). Anal. Chem.; 45: No. 11, 1950-1952(Sep 1973).

A procedure is described that is an optimization of the technique of neutron activation analysis (NAA) and the utilization of a newly developed nuclear detector known as the Low Energy Photon Detector (LEPD). The identification of mercury by this method is especially attractive because of the high cross section for production of the ^{197}Hg isotope, its 65-hr half-life, and the strong intensity of several x-rays and a low energy γ associated with its decay. Likewise, selenium (^{75}Se) with a 120-day half-life is easy to identify using two low-energy γ-rays. The analysis is strictly instrumental, thus eliminating unnecessary errors involved in the determination of chemical yields. The procedure is based on the direct measurement of the x-rays from irradiated matrices, thus allowing the same technique to be used on a wide variety of matrices. The sensitivity is 50 ng of Hg per gram of coal with a precision at this level of ±10% at 100 ppB, ±5% at 200 ppB, and ±2% at 500 ppB. For selenium, the sensitivity is approximately 150 ng per gram of coal with precision values of ±15% at 250 ppB, ±10% at 500 ppB, and ±5% at 1 ppM. (DHM)

24096 MULTIELEMENT INSTRUMENTAL NEUTRON ACTIVATION ANALYSIS OF BIOLOGICAL MATERIALS. Nadkarni, R. A.; Morrison, G. H. (Cornell Univ., Ithaca, NY). Anal. Chem.; 45: No. 11, 1957-1960(Sep 1973).

A nondestructive neutron activation analysis method is described that is capable of determining up to 36 elements, including many of the essential and toxicological trace elements. Since no chemical processing is involved, volatile elements such as As, Br, Cl, Hg, Se, and Sb are not lost in the method. Also, no chemical yields need be determined for each of the elements determined. The method uses a multielement biological standard during irradiation which is similar in matrix element composition to the samples analyzed. This minimizes differences in neutron self-shielding and absorption effects between the standard and samples, as well as eliminates the task of preparing a large number of synthetic standards. (DHM)

24097 NEUTRON ACTIVATION ANALYSIS TECHNIQUES. May, S. (CEN de Saclay, Gif-sur-Yvette, France). Ind. At. Spatiales; 17: No. 2, 31-51(Mar 1973). (In French and English).

The principal irradiation sources used in neutron activation analysis are nuclear reactors, cyclotrons, 14-MeV neutron generators, and isotope sources. After irradiation, the isotopes are measured using β^- detectors or γ spectrometry units. The complex mixtures of radionuclides produced often require the computerized processing of the measurements. This analytical technique is not entirely free from sources of error: shadow effect, effect of the radioisotope studied being produced also by nuclear reactions with the matrix. The radiochemical separation methods used involve the techniques of selective precipitation, solvent extraction, and ion exchange chromatography. The method is very sensitive and permits elements to be determined in the trace state. In addition, the method has a wide range of applications in science and industry: chemistry, biology, metallurgy, etc. and is currently in use in about 20 French laboratories. (Fr)

24098 DETERMINATION OF CARBON BY THE GAMMA-ACTIVATION METHOD WITH SEPARATION OF RADIOACTIVE CARBON-11. Gorenko, A. F.; Skakun, N. A.; Zadvornyi, A. S.; Bugaeva, N. I.; Shevchenko, G. M.; Klyucharev, A. P. (Physical Technical Inst., Kharkov). Zh. Anal. Khim.; 28: No. 6, 1227-1230 (Jun 1973). (In Russian).

Gamma-activation analysis of carbon with separation of ^{11}C is as selective as highly selective chemical methods. The activity of carbon-11 is measured by nuclear detectors with high sensitivity. The effect of the activation of the matrix, surface contamination, and oxygen current purity is of no essential importance in this method of analysis of carbon. (auth)

24099 DETERMINATION OF FLUORINE, SILICON, AND IRON IN RARE EARTH CONCENTRATES BY THE METHOD OF ACTIVATION WITH FAST NEUTRONS. Lisovskii, I. P.; Nikonov, V. N.; Smakhtin, L. A.; Troyanker, L. S. (Physical-Chemical Inst., Moscow). Zh. Anal. Khim.; 28: No. 6, 1225-1227(Jun 1973). (In Russian).

Fluorine, silicon, and iron can be determined in rare earth concentrates by the method of activation with fast neutrons. The determination accuracy is 3.1% for fluorine, 4 for silicon, and 2.8 for iron. The sensitivity of the determination is 0.05, 0.02, and 0.05% respectively. (auth)

24100 FAST NEUTRONS FOR CHEMICAL ANALYSIS. Brune, D. (Aktiebolaget Atomenergi, Studsvik, Sweden). Kem. Tidskr.; 84: No. 7-8, 36-41(1972). (In Swedish).

The functioning of a neutron generator is described as well as its application in activation analysis with fast neutrons for routine analysis of oxygen in the steel industry and for quality control of cereals for determination of nitrogen. The nuclear technique is found to be very fast. (SW)

24101 CHARACTERIZATION OF ARCHAEOLOGICAL FINDINGS BY MEANS OF ACTIVATION ANALYSIS. Terrani, M.; Villani, S. (Politecnico, Milan). Com. Naz. Engr. Nucl., Notiz.; 19: No. 5, 77-79(May 1973). (In Italian).

Activation analysis can be used with success in three areas of archaeology: (1) the determination of the exact center of production of a given artifact and the localization of the source of the material used; (2) study of ancient work techniques; and (3) the question of authenticity. Its use in these areas is discussed. The results obtained on two studies of obsidian and ceramics are reported as examples. (JSR)

24102 PECULIARITIES OF GOLD DISTRIBUTION IN GRANITOIDS OF PROTEROZOIC INTRUSIONS OF THE SOUTH-YENISEI RIDGE. Li, L. V.; Datsenko, V. M. (Siberian Scientific Research Inst. of Geology, Geophysics, and Mineral Raw Materials, Krasnoyarsk, USSR). Geokhimiya; No. 6, 848-855(Jun 1973). (In Russian).

Results of a determination by the radioactivation method of gold content in metasomatic and palingenic granitoids of the region are given. The slight enrichment in gold of the more basic and melanocratic rocks of the endocontact and central zones of the Taraksk and Posolnensk metasomatic granitoid massifs is proved. The absence of significant differences in the gold content of palingenic granites in different phases of the Nizhnekansk massif is accounted for by the inert behavior of gold during granite magma differentiation. The outlined tendency towards a decrease of gold concentration in granitoids of intrusions of a later and later formation time may be connected with peculiarities of the substrate over which the granite melt is formed and with the facial conditions of its crystallization. (auth)

24103 COMPARISON OF SEVERAL METHODS OF ACTIVATION ANALYSIS USED FOR TRACER ANALYSIS OF OXYGEN. Reimers, P. (Bundesanstalt fuer Materialpruefung, Berlin); Mayolet, F.; Engelmann, C. Radiochim. Acta; 18: No. 3, 150-153(1972). (In German).

Three nuclear reactions are discussed which lend themselves particularly well to oxygen assays by activation analysis. The limits of detection are set by the capacity of the radiation sources presently available. They are 10 ppM for the ^{16}O(n,p)^{16}N reaction, 1 ppM for the ^{16}O(γ,n)^{15}O reaction, and 5 ppB for the ^{16}O(^{3}He,p)^{18}F reaction. (GE)

24104 LIMITATIONS AND INTERFERENCES IN ACTIVATION ANALYSIS. I. Nuclear Interferences. Travesi, A.

(Junta de Energia Nuclear, Madrid). Energ. Nucl. (Madrid); 17: No. 82, 99-112(1973). (In Spanish).

After a consideration of the scope of the terms limitations and interferences, the nuclear interferences are then considered. These are classified into three groups: (1) primary, (2) secondary, and (3) caused by natural radioactivity. The entire extension of these groups of interferences is then discussed and the nuclear data relative to numerous elements and their isotopes connected with the interferences are tabulated. (tr-auth)

24105 INSTRUMENTAL NEUTRON-ACTIVATION ANALYSIS OF TROILITE (INCLUSIONS) FROM THE SIKHOTE-ALIN METEORITE. Lyul', A. Latv. PSR Zinat. Akad. Vestis; No. 2, 14-17(1972). (In Russian).

The sample is drilled out and cleaned, and a portion (≃4 mg) is sealed in polyethylene. For the determination of Al, V, Mn, and Co, the sample is irradiated for 2 min in a thermal-neutron flux of $\simeq 3 \times 10^{12}$ n/cm²/sec and, 30 sec after the end of irradiation, the induced activity of ^{60m}Co, ^{28}Al, ^{52}V, and ^{56}Mn is measured from the photo-peaks at 0.06, 1.78, 1.43, and 0.84 MeV, respectively, by means of a scintillation spectrometer with a NaI(Tl) crystal (4 cm × 5 cm). For the determination of Cu and Cr, the sample (after the decay of short-lived radio-isotopes) is irradiated for 3 hr in a neutron flux of $\simeq 6 \times 10^{12}$ n/cm²/sec then set aside for 20 hr before measurement of the activity of ^{64}Cu and ^{51}Cr from the 0.51- and 0.32-MeV photo-peaks. The limits of determination (ppM) are V 3, Mn13, Co 1.6, Cu 6.9, Cr 14, and Al 9. (Ref.Zh.)

24106 DETERMINATION OF RHENIUM IN SOOT BY NEUTRON ACTIVATION. Martin, A.; Elejalde, C. An. Quim.; 68: No. 11, 1237-1240(1972). (In Spanish).

The soot is irradiated for 1 hr in a thermal-neutron flux of $\simeq 2 \times 10^{11}$ n/cm²/sec, then set aside for 4 to 5 hr. Radiochemical separation and determination of the Re are carried out by—(i) heating the sample with concentrated HNO_3, filtering, washing the residue with HNO_3 (1 : 1), diluting the filtrate with H_2O until the HNO_3 concentration is ≃M, passing the solution through a column of Dowex 2-X10 (NO_3^- form), washing the column with 0.5M-HNO_3, removing the liquid from the column by suction and measuring the activity of ^{186}Re plus ^{188}Re on the column with a scintillation detector; or (ii) heating the sample with an equal weight of $Ca(OH)_2$ at 550 to 600°C for 15 to 20 min, dissolving the residue in the minimum volume of dilute HCl, centrifuging, adjusting the acidity of the solution to ~0.5M-HCl, passing the solution through a Dowex 2-X10 column (Cl^- form), washing the column with 0.1M-HCl and measuring the Re activity as before. Only Hg interferes, and the limit of determination is 0.1 ppM of Re. (Anal. Abstr.)

24107 TRACE ELEMENT CONTENT OF ROMAN LEAD BY NEUTRON ACTIVATION ANALYSIS. Wyttenbach, A.; Schubiger, P. A. (Eidgenoessisches Inst. fuer Reaktorforschung, Wuerelingen, Switzerland). Archaeometry; 15: No. 2, 199-207(Jul 1973).

A report is presented on the analysis of Roman lead artefacts for impurities by neutron activation. The experimental procedure is outlined and the results discussed. It is shown that instrumental neutron activation analysis with computer reduction of the Ge(Li)-γ-spectra is a valuable tool to determine trace contents of Cu, As, Ag, Sn, Sb, and Au in lead samples; the method is fast, works with 200 mg samples and shows an experimental reproducibility of ±7% in the ppM range. (UK)

24108 CHARACTERIZATION OF SAMIAN WARE SHERDS BY MEANS OF NEUTRON ACTIVATION ANALYSIS. Banterla, G. (Univ., Pavia, Italy); Stenico, A.; Terrani, M.; Villani, S. Archaeometry; 15: No. 2, 209-220(Jul 1973).

A report is presented on the neutron activation analysis of Samian ware sherds. A Ge(Li) gamma-ray detector was used. Peak intensities for 22 γ-emitters were measured for 10 groups of Samian ware (Terra Sigillata) sherds. Characterization was based on counting rate ratios among different radio-nuclides. It was known from archaeological evidence that 7 groups belong to the Arretine production, the remaining three having a different origin. The principal aim was to check the degree of compositional uniformity of the Arretine groups, compared with groups of different origin. The experimental procedure is outlined and the results discussed. (UK)

24109 DETERMINATION OF PLATINUM IN GLASSES CONTAINING BORON BY MEANS OF NEUTRON ACTIVATION ANALYSIS. Menke, H.; Weber, M. (Univ., Mainz). (1973). vp. (In German).

From meeting of the Gesellschaft Deutscher Chemiker on trace analysis; Erlangen, Germany (2 Apr 1973).

Low platinum contents in the range below 1 ppM that greatly influence the optical properties of glasses can be determined by neutron activation analysis. The high matrix activation of the glass sample does not allow a direct measurement of the platinum isotopes. The platinum is determined via the β^- daughter product of ^{199}Pt, i.e., the 3.15 d ^{199}Au, for which a glass digestion followed by a carrier separation of gold was developed. The self-shielding resulting from the boron content of the glasses was studied as a function of matrix and boron concentration. (GE)

Chemical and Spectral Procedures

Refer also to abstracts 24604, 24615, 24699, 24702–24704, 24721, 24743–24745, 24748, 24925, 24979, 25238, 26236, 26879, 26880, and 26940.

24110 (IEA-276) VOLUMETRIC DETERMINATION OF THE O/U RATIO IN PELLETS OF THE CERAMIC OXIDES UO_{2+x} AND $UO_{2+x} \cdot ThO_2$. Federgruen, L.; Abrao, A. (Instituto de Energia Atomica, Sao Paulo (Brazil)). Oct 1972. 18p. (In Portuguese). (CONF-720734-1). Dep. NTIS (U. S. Sales Only) $3.00.

From 24th annual meeting of the Brazilian Society for the progress of science (SBPC); Sao Paulo, Brazil (Jul 1972).

A technique is outlined for the O/U ratio determination in UO_{2+x} and $UO_{2+x} \cdot ThO_2$ sintered pellets. Tetravalent uranium and total uranium were analysed by titration after dissolution with phosphoric acid, with the aid of CO_2 during the titration avoiding the oxidation of reduced uranium. The difficulties concerning the dissolution of the ceramic grade oxides were overcome satisfactorily, especially for those oxides containing thorium. The titration of uranium(IV) in the presence of thorium was run with potassium permanganate, overcoming the difficulties found when the titration was tried with potassium dichromate. The effect of thorium during the uranium titration was studied. The O/U ratio was calculated after the determination of total uranium and uranium (IV). (auth)

24111 (JEN-243) METHOD FOR DETERMINING MICRO-AMOUNTS OF URANIUM IN SOLUTIONS FROM COPPER ORES BY LIQUID-LIQUID EXTRACTION AND SPECTROPHOTOMETRY WITH ARSENAZO III. Rodriguez Hernandez, B. (Junta de Energia Nuclear, Madrid (Spain)). 1972. 12p. (In Spanish). INIS.

A spectrophotometric method is described for determining small amounts of uranium in aqueous solutions from copper ores. Uranium is quantitatively separated in a single extraction. An aliquot of the extract is diluted with an alcoholic solution of arsenazo III. Optical density is measured at 650 nm. Relative error less than 10% is obtained for samples containing between 1 and 5 mg U/l, in presence of iron and copper up to 10 g Fe/l and 40 g Cu/l. (auth)

24112 (JUL-Conf-8) QUANTITATIVE ANALYSIS WITH ELECTRON MICROPROBES AND SECONDARY ION MASS SPECTROMETRY. Meeting held at Kernforschungsanlage Juelich, Germany, October 18–20, 1972. Preuss, E. (ed). (Kernforschungsanlage, Juelich (West Germany). Institut fuer Technische Physik). Mar 1973. 365p. (In English and German). (CONF-7210102-).

"Electron Probe Microanalysis" is discussed in the following 12 papers: the quantitative microprobe analysis, absorption and atomic number correction, continuum fluorescence correction, small concentrations and detection limit, errors in electron probe microanalysis, atomic number correction for bulk materials and thin layers, Monte-Carlo calculation for electron diffusion, application of Monte-Carlo calculations, practicability of Monte-Carlo technique, small thicknesses of layers in the monolayer region, thickness and composition of surface films in the electron probe x-ray microanalyser, quantitative analysis of thin layers. Four papers are given on "Secondary Ion Mass Spectrometry", on physical effects and application possibilities, apparative basis and application of image-forming spectrometers, analysis of thin surface layers, and analysis of monolayers to detect compounds. (GE)

24113 COPRECIPITATION AS A MEANS OF SEPARATION IN SUBSTOICHIOMETRIC ISOTOPE DILUTION ANALYSIS. II. Determination of Chromium. Polak, H. L.; de Groot, H.; Challa, E. E. (Univ. of Amsterdam). J. Radioanal. Chem.; 13: No. 2, 319-327(Feb 1973).

Chromium was determined by isotope dilution in artificial standards and in standard alloys using the substoichiometric principle. As a substoichiometric reaction the reduction of Cr(VI) to Cr(III) was used, followed by separation of these species by coprecipitation of the trivalent chromium on a $Ti(OH)_4$ precipitate. For amounts smaller than 1 μg the standard method had to be modified owing to spontaneous reduction of hexavalent chromium in the solution. Interferences from other metals, if they occur, can be easily overcome. The method is simple and inexpensive. (auth)

24114 COLOR REACTION OF TANTALUM WITH PYROCATECHOL VIOLET IN THE PRESENCE OF CETYLPYRIDINIUM

BROMIDE. Nakashima, R.; Sasaki, S.; Shibata, S. (Government Industrial Research Inst., Nagoya, Japan). Jap. Anal.; 22: No. 6, 729-732(Jun 1973). (In Japanese).

An aliquot of tantalum solution (tantalum: 4.5 to 45 μg, 1:1 sulfuric acid solution) was taken in a 10 ml beaker, and evaporated to almost dryness on a sand bath. After addition of 0.5 to 1.0 ml of concentrated sulfuric acid, the vessel was covered with a watch glass, and heated for 20 to 30 min. The beaker and its content was stood for 10 min, and then 3.0 ml of 0.1% pyrocatechol violet (PV) solution and 2.0 ml of 2.0×10^{-2} M cetylpyridinium bromide (CPB) solution were added. The mixture was transferred entirely to a 25 ml volumetric flask containing preliminary 5.0 ml of 1:1 hydrochloric acid. The content was gently mixed and diluted exactly to the mark with water. Absorbance was measured at 605 nm against the reagents blank. The quantities of reagents for obtaining optimum conditions were; 1:1 hydrochloric acid 5.0 to 8.0 ml, 0.1% PV 2.0 ml. The absorbance was unchanged for at least 20 hrs. Calibration curve was straight line from 4.5 to 45 μg/25 ml of tantalum. The order of addition of reagents was essential to obtain a reproducible result. (DHM)

24115 AUTOMATED EVALUATION OF PHOTOGRAPHICALLY RECORDED MASS SPECTRA. Frisch, M. A.; Reuter, W. (IBM Watson Research Center, Yorktown Heights, NY). Anal. Chem.; 45: No. 11, 1889-1897(Sep 1973).

A program was developed for the semiquantitative evaluation of photographically recorded spark source mass spectra. The densitometer readings are transformed into relative intensities, considering the mass dependence of the photographic response and the instrumental transmission characteristics. Line assignments are made, accurate within 5 to 30 millimass units, depending on the mass. Most interference problems are quantitatively evaluated. Many notations are used to aid the analyst in the interpretation of the data. Finally the concentration for each element is calculated in parts per million. (auth)

24116 SPECTROPHOTOMETRIC DETERMINATION OF URANIUM IN THORIUM TETRAFLUORIDE. Okumura, I.; Shimada, S.; Higashi, K. (Kyoto Univ.). Anal. Chem.; 45: No. 11, 1945(Sep 1973).

A rapid and accurate method is proposed for determining U in ThF_4 by spectrophotometry in combination with a pretreatment step. The pretreatment consists of dissolving a solid sample in $H_3BO_3-HClO_4$ solution, fuming to dryness, and stabilizing by adding base. (DHM)

24117 SOLVENT EXTRACTION OF METAL 1,10-PHENANTHROLINE COMPLEXES AND CONCENTRATION OF TRACE AMOUNTS OF METAL IONS PRIOR TO SPECTROPHOTOMETRIC OR FLAME PHOTOMETRIC DETERMINATION. Schilt, A. A.; Abraham, R. L.; Martin, J. E. (Northern Illinois Univ., DeKalb). Anal. Chem.; 45: No. 11, 1808-1811(Sep 1973).

The use of 1,10-phenanthroline as an extraction reagent to facilitate separation and concentration of metal ions prior to their determination was investigated. Various solvents, anions, and solution conditions were evaluated to discover optimum conditions and procedures for quantitative extractions. Distribution ratios, extraction efficiencies, and identities of extracted complexes were determined for a number of selected metal ions (including Mo^{4+}). The effectiveness of 1,10-phenanthroline as an extraction reagent was demonstrated by its application to determine trace amounts of zinc and iron in water. Nitrobenzene was not only effective as an extraction solvent but also suitable as an aspiration solvent for flame spectrometry. (auth)

24118 MESITYL OXIDE AS AN EXTRACTING AGENT FOR BERYLLIUM. Dhond, P. V.; Khopkar, S. M. (Indian Inst. of Tech., Bombay). Anal. Chem.; 45: No. 11, 1937-1938(Sep 1973).

Beryllium is quantitatively extracted from hydrochloric acid containing potassium thiocyanate. The metal can be stripped from the organic phase with water and determined photometrically at 530 nm, as its complex with aluminum. (DHM)

24119 LEAD SEPARATION BY ANODIC DEPOSITION AND ISOTOPE RATIO MASS SPECTROMETRY OF MICROGRAM AND SMALLER SAMPLES. Barnes, I. L.; Murphy, T. J.; Gramlich, J. W.; Shields, W. R. (National Bureau of Standards, Washington, DC). Anal. Chem.; 45: No. 11, 1881-1884(Sep 1973).

A method is reported for the separation by anodic deposition and subsequent analyses by isotope ratio mass spectrometry of small samples of lead from a variety of matrices. The combined procedure is applicable to samples containing from 10 μg to less than 10 ng of lead and the electrodeposition is more than 95% efficient at these levels. Only a few elements interfere with the deposition, most notably iron and cerium, and procedures for removing the interfering elements are given. The optimum conditions for the anodic deposition of lead as PbO_2 were studied. The mass spectrometric procedure described permits a precision of 0.1% (95% limit of error) or better for the measured isotopic ratios. (auth)

24120 SIMULTANEOUS DETERMINATION OF RARE EARTHS BY ION EXCHANGE CHROMATOGRAPHY. Brunisholz, G.; Collet, P.; Klipfel, L.; Roulet, R. (Univ., Lausanne, Switzerland). Rev. Chim. Miner.; 10: No. 1, 131-139(1973). (In French).

A displacement chromatography technique is described for the simultaneous determination of La, Ce, Pr, Nd, Sm, Gd, Tb, Dy, Ho, and Y. The quantity of rare earth necessary for the analysis is of the order of 1 mg; the accuracy achieved is of the order of 1%. The method can be used for the determination of trace amounts. (Fr)

24121 QUARTERNARY AMMONIUM BASES AS ANALYTICAL REAGENTS. Communication 3. Precipitation of Neptunium with N-benzylquinolinium Nitrate. Markov, G. S.; Nikol'skii, B. P.; Posvol'skii, M. V. (Radium Inst., Leningrad). Zh. Anal. Khim.; 28: No. 6, 1217-1218(Jun 1973). (In Russian).

A gravimetric method for determining neptunium was developed based on the reaction of the precipitation of neptunium (IV) from 6 to 8M nitric acid with N-benzylquinolinium nitrate as $(C_{16}H_{14}N)_2[Np(NO_3)_6]$. Conditions were studied for the precipitation of neptunium from nitric acid solutions. (auth)

24122 LUMINESCENCE DETERMINATION OF MICROIMPURITIES OF SOME LANTHANIDES IN LANTHANUM OXIDE OF HIGH PURITY. Efryushina, N. P.; Poluektov, N. S.; Smirdova, N. I.; Kudryshov, V. A. (Inst. of General and Inorganic Chemistry, Odessa). Zh. Anal. Khim.; 28: No. 6, 1213-1216(Jun 1973). (In Russian).

The luminescence of Tb^{3+}, Dy^{3+}, and Ho^{3+} ions in lanthanum oxychloride was studied. The crystallophosphors were synthesized by the ignition of $LaCl_3 \cdot 6H_2O$ for 20 min with an additive of a rare earth salt at 800°. A method was developed for determining Tb^{3+}, Dy^{3+}, and Ho^{3+} in lanthanum oxide with the sensitivity of between 1×10^{-4} and 6×10^{-6}%. (auth)

24123 EXPERIMENT DESIGN IN THE DEVELOPMENT OF KINETIC METHODS OF ANALYSIS. Construction of a Mathematical Model and Selection of Optimal Conditions for Determination of Molybdenum. Ruzinov, L. P.; Alekseeva, I. I.; Khachaturyan, E. G. (Moscow Inst. of Fine Chemical Tech.). Zh. Anal. Khim.; 28: No. 6, 1109-1114(Jun 1973). (In Russian).

Experimental design for development of kinetic methods of analysis is discussed. A mathematical model was constructed for the reaction of iodide with hydrogen peroxide in the presence of molybdenum. Optimal conditions for determination of molybdenum were found. (auth)

24124 CHEMICAL-SPECTRAL METHOD OF ANALYSIS OF RHENIUM OF HIGH PURITY USING SOLVENT EXTRACTION OF THE MAIN COMPONENT WITH TRIOCTYLAMINE OXIDE. Yudelevich, I. G.; Shaburova, V. P.; Torgov, V. G.; Shcherbakova, O. I. (Inst. of Inorganic Chemistry, Novosibirsk, USSR). Zh. Anal. Khim.; 28: No. 6, 1049-1054(Jun 1973). (In Russian).

The extraction of rhenium using a toluene solution of trioctylamine from solutions of nitric, hydrochloric, and sulfuric acids and from hydrogen peroxide solution was studied. An extraction-spectral method was developed for the determination of microimpurities of As, Al, Ba, Be, Bi, Fe, In, Cd, Co, Ca, Mg, Mn, Si, Sb, Tl, Te, Ni, Cr, Pb, and Zn in rhenium of high purity with the sensitivity of 2×10^{-4} to 1×10^{-7}%. The impurities are preliminary concentrated by the main component extraction. (auth)

24125 DETERMINATION OF TELLURIUM(IV) AND SELENIUM (IV) BY ANODIC STRIPPING VOLTAMMETRY USING CO-DEPOSITION WITH COPPER. Araki, S.; Suzuki, S.; Kuwabara, T. (Tokyo Metropolitan Univ.). Jap. Anal.; 22: No. 6, 700-707(Jun 1973). (In Japanese).

Electrolytic co-deposition of tellurium with copper was carried out with a constant current in solutions containing 1×10^{-5} M to 2.3×10^{-4} M tellurium(IV), 1×10^{-4} M copper(II) and 0.64 M nitric acid. The deposit on a rotating platinum electrode (RPE) was stripped in 1 M sulfuric acid with a linear potential sweep in the voltage range of 0 to +1.0 V vs. SCE. The scan rate was 0.21 V/min, and the counter electrode was a saturated calomel electrode (SCE). In the stripping step, sulfuric acid in concentrations of 0.25 to 3 M was the most suitable supporting electrolyte. The first peak appearing in the stripping voltammogram resulted from the dissolution of copper. The second peak appearing at +0.75 volt was the stripping peak of tellurium. The area of the second peak was proportional to the concentration of tellurium(IV) in the deposition step. Linear dynamic range was 1×10^{-5} to 2.3×0^{-4} M tellurium(IV). The mean deviation was 2.4% or less. The effects of concentration of copper in the deposition step on the peak area of

tellurium were investigated. No effect was observed when the concentration of copper was three times as high as that of tellurium. One molar sulfuric acid solutions containing 1×10^{-5} M to 2.2×10^{-4} M in respect to selenium(IV) and 3×10^{-4} M in respect to copper(II) were subjected to the electrolytic co-deposition of selenium with copper. The deposit on RPE was stripped according to the same procedure except for the voltage range of 0 to +1.5 V vs. SCE. The peak potential of selenium was +1.21 V vs. SCE. The area of this peak was proportional to the concentration of selenium in the range of 1×10^{-5} M to 2.2×10^{-4} M. When tellurium and selenium coexisted in the electrolyte, they interfered the determination with each other. (DHM)

24126 DETERMINATION OF MICROAMOUNTS OF DIFFICULTLY VOLATILIZED ELEMENTS BY FLAME EMISSION DURING PULSE EVAPORATION FROM A HEATED MICROPROBE. Prudnikov, E. D.; Shapkina, Yu. S. (Leningrad State Univ.). Zh. Anal. Khim.; 28: No. 6, 1055-1058(Jun 1973). (In Russian).

Direct pulse evaporation into the flame lowers the detection limits for elements in emission flame spectrophotometry. The method can be used for determination of ultrasmall amounts of elements and for analysis of microsamples. In case of the determination of difficultly volatilized elements or microamounts of elements in difficultly volatilized materials, uses of the method are much broader if an additional energy supply is applied for decreasing the evaporation into the flame time, in particular by complementary heating the microprobe with an electric current. The determination of Al, Er, Mo, V, and Sr is used as an example. (auth)

24127 CHEMICAL ANALYSIS OF RUTILE: A PYROCATECHOL VIOLET SPECTROPHOTOMETRIC PROCEDURE FOR THE DIRECT MICRODETERMINATION OF ZIRCONIUM. Meyrowitz, R. J. Res. U. S. Geol. Surv.; 1: No. 5, 549-554(1973).

The ZrO_2 content of rutile is determined spectrophotometrically by a direct pyrocatechol violet procedure. The sample is decomposed by potassium pyrosulfate fusion in a transparent quartz crucible, and a sulfuric acid solution of the melt is used for the determination at a pH of 5.1. Of the elements commonly present in rutile, only titanium and niobium occur in concentrations large enough to interfere. Titanium and niobium interference is overcome by adding the titanium and niobium contents of the sample to the standard zirconium solutions used for the standard zirconium curve. The absorbance is measured at 570 nm. Beer's law is obeyed within the range of 0.05 to 1.50 ppM ZrO_2. In the presence of 50 ppM TiO_2, the range is 0.15 to 1.50 ppM ZrO_2. The tolerances of 47 elements were determined. The sensitivity is 0.0058 μg Zr/cm^2. The variables in the method were studied, and typical results are given for commercial rutile concentrates. (auth)

24128 SPECTROPHOTOMETRIC DETERMINATION OF TUNGSTEN IN ROCKS BY AN ISOTOPE DILUTION PROCEDURE. Lillie, E. G.; Greenland, L. P. J. Res. U. S. Geol. Surv.; 1: No. 5, 555-558(1973).

Samples are decomposed with hydrofluoric acid and perchloric acid in the presence of ^{181}W tracer. Molybdenum is extracted from a hydrochloric acid solution with tributyl phosphate. Tungsten is separated from most other elements by extraction of the α-benzoinoximate into chloroform. Stannous chloride in concentrated hydrochloric acid is used to strip tungsten and reduce it to W^{5+}. The amount of tungsten is determined spectrophotometrically after extraction as the thiocyanate complex into amyl alcohol. The correction for chemical losses is determined by counting ^{181}W. (auth)

24129 SPECTROCHEMICAL COMPUTER ANALYSIS: ARGON–OXYGEN DC ARC METHOD FOR SILICATE ROCKS. Dorrzapf, A. F. Jr. J. Res. U. S. Geol. Surv.; 1: No. 5, 559-562(1973).

Use of an argon–oxygen atmosphere eliminates the interference of cyanogen bands with many sensitive analytical lines. The jet-controlled atmosphere also improves the stability of the arc. These procedural changes, coupled with computerized analysis of the spectra, result in increased detectability, precision, and speed as compared to the former visual semiquantitative technique. Detection limits and useful concentration ranges for individual lines of 68 elements are tabulated. Among the elements determined are Cs, Dy, Er, Eu, Gd, Ho, La, Lu, Mo, Nb, Nd, Pr, Ru, Sc, Sm, Sr, Tb, Te, Th, Tm, U, Y, Yb, and Zr. (JGB)

24130 DETERMINATION OF MOLYBDENUM AND TUNGSTEN WITH IODIDE ACTIVITY ELECTRODE. Altinata, A.; Pekin, B. (Ege Univ., Izmir, Turkey). Anal. Lett.; 6: No. 8, 667-673(1973).

A new method for the determination of molybdenum and tungsten is described based on their catalysis of the hydrogen peroxide–iodide reaction as monitored with an iodide ion-selective electrode. This method yields better results than methods previously used. As little as 0.004 μg/ml of molybdenum and tungsten is determinable. (auth)

24131 CATHODE-REGION METHOD FOR THE SPECTROCHEMICAL DETERMINATION OF TRACE ELEMENTS IN RARE-EARTH OXIDES. Avni, R. (Israel Atomic Energy Commission, Beersheba); Harell, A.; Lourenco, A. S. pp 1-6 of Application of Different Spectroscopic Methods to the Solution of Problems in Chemical Analysis. London; Adam Hilger Ltd. (1972).

From 16th international conference on spectroscopy; Heidelberg, Federal Republic of Germany (4 Oct 1971). See CONF-711015-(V1 and V2).

A direct spectrochemical method was described for the determination of trace elements in rare-earth (R.E.) matrices, using a dc arc plasma, burning in air at atmospheric pressure. The matrices investigated were oxides of Ce, Dy, Eu, Gd, Ho, La, Nd, Pr, Sm, Y, and Yb. About 37 trace elements were analyzed in each matrix. (auth)

24132 DETERMINATION BY PHOTOELECTRIC SPECTROMETRY OF ELEMENTS PRESENT AS TRACES IN NATURAL MATERIALS: CORRECTIONS OF SPECTRAL BACKGROUNDS AND MATRIX EFFECT. Martinez, Y.; Maol, J. Y.; Ruel, G. (Bureau de Recherches Geologiques et Mineres, Orleans, France). pp 203-208 of Application of Different Spectroscopic Methods to the Solution of Problems in Chemical Analysis. London; Adam Hilger Ltd. (1972). (In French).

From 16th international conference on spectroscopy; Heidelberg, Federal Republic of Germany (4 Oct 1971). See CONF-711015-(V1 and V2).

A program of corrections for the emission spectrometric determination of 22 trace elements in natural geological materials was developed. The program is made up of calculations of spectral background and interferences, corrections for matrix effects, and determination curves. The corrections were applied to the analysis of geochemical samples of national and international origin for trace amounts of Be, B, Sr, Sc, V, Cr, Mn, Co, Ni, Cu, Zn, Ga, Ge, Y, Mo, Ag, Cd, Sn, Ba, Yb, Pb, and Bi. The major constituents of the materials analyzed were SiO_2, Al_2O_3, Fe_2O_3, FeO, MgO, CaO, K_2O, and Na_2O. Results indicate an improvement in reproducibility, sensitivity, and precision of the analytical method. (JGB)

24133 IMPLICATIONS IN THE USE OF SECONDARY ION MASS SPECTROMETRY TO INVESTIGATE IMPURITY CONCENTRATION PROFILES IN SOLIDS. Schulz, F.; Wittmaack, K.; Maul, J. (Gesellschaft fuer Strahlen- und Umweltforschung mbH, Nuremberg, Ger.). Radiat. Eff.; 18: No. 3-4, 211-215(1973).

Using a recently developed high sensitivity secondary ion mass spectrometer the influence of the sputtering ion energy (5- to 50-keV argon) on the original range distribution was investigated with a standard implantation profile as a reference (20-keV boron in amorphous silicon). It was found that recoil processes change the distribution only in the long range tail so that projected range and standard deviation are not influenced by this effect within the limits of experimental accuracy. Because of the low sputtering yield of silicon ($S \leq 2$ atoms/ion), however, there is a change in sputtering rate at the beginning of layer removal until equilibrium between implantation and release of argon is obtained. This effect results in an increase in the measured value of the projected range, which can be corrected by extrapolation to zero sputtering energy ($R_p = 690$ Å, $\Delta R_p = 280$ Å). Neither scanning electron microscopy nor talysurf measurements showed any indication for the development of a surface topography after sputtering silicon layers up to 5000 Å in thickness. (auth)

24134 PRECONCENTRATION AND SPECTROCHEMICAL DETERMINATION OF TRACES OF IMPURITIES IN NUCLEAR MATERIALS. Berthelot, C. A.; Di Branco, G.; Herrmann, S.; Mencarelli, T. (Commission des Communautes Europeennes, Geel, Belg.). pp 55-63 of Application of Different Spectroscopic Methods to the Solution of Problems in Chemical Analysis. London; Adam Hilger Ltd. (1972). (In French).

From 16th international conference on spectroscopy; Heidelberg, Federal Republic of Germany (4 Oct 1971). See CONF-711015-(V1 and V2).

Methods of preconcentration were developed in order to determine by emission spectroscopy trace amounts of elements present in concentrations of <1 ppM in these materials having nuclear or metallurgical interest: D_2O, Li, C, Fe, Cu, U, and the transuranium elements. The elements of particular interest in this study are: B, Be, Cd, Cr, Dy, Eu, Gd, Li, Mo, Nb, Ru, Sb, Sm, Ta, Ti, V, W, and Zr. Methods used for the separation of the matrix from impurities are: volatilization, combustion, fractional distillation, ion exchange, coprecipitation, solvent extraction, and electrolysis. Limits of detection for various methods are given. (JGB)

24135 CHEMICAL SEPARATION AND CONSECUTIVE DETERMINATION OF RARE EARTH ELEMENTS IN ROCKS AND MINERALS. Tripkovic, M.; Cosovic, N. (Inst. for Tech. of Nuclear and Other Mineral Raw Materials, Belgrade). pp 471-474 of Application of Different Spectroscopic Methods to the Solution of Problems in Chemical Analysis. London; Adam Hilger Ltd. (1972).

From 16th international conference on spectroscopy; Heidelberg, Federal Republic of Germany (4 Oct 1971). See CONF-711015-(V1 and V2).

A method involving a pre-separation step was developed for the determination of Sc, La, Gd, Eu, Ho, Sm, Tm, Lu, Ce, and Tb in rocks and minerals. The finely ground rock or mineral is weighed and then fused with N_2O_2 in an iron crucible. The contents of the crucible are boiled with water, filtered, and dissolved with a mixture of nitric acid and water. Yttrium oxide is added and the solution is then precipitated with ammonium hydroxide. The separation and concentration of rare earth elements was carried out with an enrichment factor of 10. The effect of NaF, NaCl, CsF, and KCl buffers on the intensities of the spectral lines is also examined. (DHM)

24136 SPECTROCHEMICAL ANALYSIS OF RARE ELEMENTS IN SILICATES. Tripkovic, M.; Amirshahi, L.; Dmitrovic, M. (Inst. for Tech. of Nuclear and Other Mineral Raw Materials, Belgrade). pp 467-470 of Application of Different Spectroscopic Methods to the Solution of Problems in Chemical Analysis. London; Adam Hilger Ltd. (1972).

From 16th international conference on spectroscopy; Heidelberg, Federal Republic of Germany (4 Oct 1971). See CONF-711015-(V1 and V2).

A spectrochemical method is described for determining traces of Au, Ga, In, Ag, Pd, Be, Bi, Pb, Mo, Sn, W, Cu, Tl, and Cr in silicates of different compositions. Comparison of different buffers led to the conclusion that the best results could be obtained with a buffer containing one part of sulfur and two parts of sodium fluoride. Detection limits ranged from 0.1 ppM for Cu to 10 ppM for W. (DHM)

24137 COOLED TWIN HOLLOW CATHODE LAMP FOR DETERMINATION OF CONCENTRATION RATIOS OF STABLE ISOTOPES. Toeroek, T.; Zaray, G. (Univ. of Budapest). pp 234-238 of Application of Different Spectroscopic Methods to the Solution of Problems in Chemical Analysis. London; Adam Hilger Ltd. (1972). (In German).

From 16th international conference on spectroscopy; Heidelberg, Federal Republic of Germany (4 Oct 1971). See CONF-711015-(V1 and V2).

A short review is given of the methods used for the determination of stable isotope concentration ratios and of designs of hollow cathode sources for optical emission spectral analysis. The aim was to build a twin hollow cathode cooled by liquid air, in which delicate metal-glass seals are avoided, at the same time enabling the excitation of the standard material under the same experimental conditions. The D.C. source delivers 1 kV to 2 channels. The current intensity in the channels can be balanced by a change in the resistance R_2. The vacuum system has suitable traps and an absorption tube to avoid impurities. The cathode bodies of the twin hollow cathodes are joined to the glass by normal ground joints. In the final construction, the cathodes were made from pure aluminium (99.99%). The inner wall of the cathode was coated with the sample by freezing during centrifugation. The optical instrumentation consisted of a glass spectrograph (ISP 51), with 3 prisms in autocollimation, and a piezoelectric scanning Fabry-Perot interferometer. (auth)

24138 CONTRIBUTION TO THE DETERMINATION OF SMALL QUANTITIES BY THERMONIZATION MASS SPECTROMETRY. Gusmini, S.; Cesario, J.; Fauconnier, J. C.; Soret, C. (CEA, Montrouge, France). pp 161-167 of Application of Different Spectroscopic Methods to the Solution of Problems in Chemical Analysis. London; Adam Hilger Ltd. (1972). (In French).

From 16th international conference on spectroscopy; Heidelberg, Federal Republic of Germany (4 Oct 1971). See CONF-711015-(V1 and V2).

Quantities of 10^{-11} g of uranium were mass analyzed with a highly sensitive technique. Special care must be taken to prevent contamination of the sample by traces of the element in dust, laboratory material, and reagents. Consequently reagents have been tested by dilution methods and appear to contain relatively important quantities of U and Ce, which explain the blank values found. Special purification of some reagents may be done. If the analyzed isotopes do not exist naturally, the contamination problem is not important. Then the maximum sensitivity of the method can be reached and mass spectrometry can be used to complete or to replace radiometry. (auth)

24139 SPECTRAL, CHEMICAL-SPECTRAL, FLAME-PHOTOMETRICAL, AND ATOMIC-ABSORPTION METHODS OF THE ANALYSIS OF HIGH PURITY CHEMICAL REAGENTS. Yudelevich, I. G.; Kustas, V. L.; Lazebnaya, G. V.; Fedyashina, A. F.; Poleva, G. V. (Inst. of Inorganic Chemistry, Novosobirsk, USSR). pp 64-67 of Application of Different Spectroscopic Methods to the Solution of Problems in Chemical Analysis. London; Adam Hilger Ltd. (1972).

From 16th international conference on spectroscopy; Heidelberg Federal Republic of Germany (4 Oct 1971). See CONF-711015-(V1 and V2).

Direct spectral methods are described for determining impurities in Li, Rb, and Cs salts. Chemical-spectral methods are given for samples with lower concentrations of impurities. The methods involve the concentration of impurities by solvent extraction procedures. Methods were developed for the determination of Na, K, Li, Rb, and Cs in various salts of rare alkaline metals by photometry. Atomic absorption methods were developed for the determination of Fe, Co, and Ni in various salts of Li, Rb, and Cs. (DHM)

24140 ELECTRODEPOSITION OF TRACE ELEMENTS ON MERCURY-COATED ELECTRODES FOR SPECTROCHEMICAL DETERMINATION BY HIGH-VOLTAGE SPARK EXCITATION. Alvarez, R. (National Bureau of Standards, Washington, DC); Darr, M. M.; Scribner, B. F.; Belkas, E. pp 44-48 of Application of Different Spectroscopic Methods to the Solution of Problems in Chemical Analysis. London; Adam Hilger Ltd. (1972).

From 16th international conference on spectroscopy; Heidelberg, Federal Republic of Germany (4 Oct 1971). See CONF-711015-(V1 and V2).

A method for preconcentration of elements to be used in a spectrochemical procedure is described that is based on electrodeposition on mercury-coated electrodes. Preliminary experimentation was made in applying this electrodeposition technique to the determination of trace elements in a special glass. A relative standard deviation of 10% was obtained for Co, Cr, Ga, In, Mo, Ni, and Zn at concentrations ranging from 0.4 to 0.8 μg/g. (DHM)

24141 DETERMINATION OF CERIUM AND LANTHANUM BY FLAME SPECTROMETRY. Bek, F.; Sychra, V. (Technical Univ., Prague). pp 341-346 of Application of Different Spectroscopic Methods to the Solution of Problems in Chemical Analysis. London; Adam Hilger Ltd. (1972).

From 16th international conference on spectroscopy; Heidelberg, Federal Republic of Germany (4 Oct 1971). See CONF-711015-(V1 and V2).

A comparison is made of atomic flame emission and molecular emission of lanthanum and cerium in various flames using the same experimental equipment. The main attention is given to the molecular-band emission in a nitrous oxide–hydrogen flame and to possible spectral interferences from the other rare earths. (DHM)

24142 NEW METHOD FOR QUANTITATIVE ANALYSIS OF TANTALUM AND NIOBIUM ORES BY X-RAY FLUORESCENCE. de Souza, O.; Fujimori, K. (Centro Tecnico Aerospacial, Sao Jose dos Campos, Brazil). pp 304-313 of III Interamerican Conference on Materials Technology. Buenos Aires; Centro Regional de Ayuda Tecnica (1972). (In Spanish).

From 3rd Inter-American conference on materials technology; Rio de Janeiro, Brazil (14 Aug 1972). See CONF-720832-.

The main problems that appear in the analysis of columbite–tantalite ores by x-ray fluorescence spectrometry are: (a) overlapping of Nb and Ta radiations; (b) heterogeneity between samples and standards; (c) large range of concentrations of Nb_2O_5 and/or Ta_2O_5, which may vary between 4 and 80%, causing large differences in absorption between samples. In order to avoid the overlapping of the Nb and Ta radiations and those of Nb and La, it is convenient to use a Si (or Ge) analysing crystal, which eliminates the second-order reflections. To avoid the heterogeneity between samples and standards it was found necessary to melt both samples and standards. Using La_2O_3, one can lower the melting point of highly refractory oxides and also lower the difference in absorption between samples, rending uniform the matrix effect, so that the calibration curve becomes a straight line. Besides Ta and Nb, Fe, Mn, Ti, and Zr were also analyzed using only the Si crystal analyser. 13 tables, 22 figures. (auth)

24143 EFFECT OF ALKALI METAL SALTS ON TUNGSTEN SPECTROGRAPHIC DETERMINATION IN MOLYBDENUM. Tarasevich, N. I.; Khlystova, A. D.; Shuvalova, E. I. Vestn. Mosk. Univ., Ser. II. Khim.; 14: No. 2, 204-207(1973). (In Russian).

The effect of four alkali metal halides (LiCl, NaCl, KCl, and CsCl) on the intensity of tungsten spectral lines in molybdenum

solutions was investigated. The sensitivity of the method was found to be 4×10^{-6} g/ml with the coefficient of variation 11%. (auth)

24144 HYDROGEN ISOTOPIC COMPOSITION OF NBS AND IAEA STABLE ISOTOPE WATER REFERENCE SAMPLES. Coplen, T. B.; Clayton, R. N. (Univ. of California, Riverside). Geochim. Cosmochim. Acta; 37: No. 10, 2347-2349(Oct 1973).

The hydrogen isotopic compositions of several isotope water reference samples were determined on a cycloidal double-collecting isotope ratio mass spectrometer that can resolve HD^+ from the "contaminant" H_3^+ ion beam. (auth)

24145 DETERMINATION OF THE O/U-RATIO OF NON-STOICHIOMETRIC URANIUM DIOXIDE BY MEANS OF SPECTROPHOTOMETRY. Kuhn, E. (Kernforschungszentrum, Karlsruhe, Ger.); Baumgaertel, H.; Schneider, H.; Goergenyi, T. (1973). vp. (In German).

From meeting of the Gesellschaft Deutscher Chemiker on trace analysis; Erlangen, Germany (2 Apr 1973).

A method for the determination of the oxygen–metal ratio of superstoichiometric uranium dioxide is described. After dissolution of the uranium dioxide in hot concentrated phosphorus acid, the concentrations of U^{4+} and U^{6+} are determined via the extinctions of two specific wave lengths. The method is simple and needs little time. It was tested for O/U–ratios between 2.05 and 2.67. The reproducibility is ±0.005 with respect to the O/U–ratio. (auth)

24146 EXTRACTION OF MOLYBDENUM FROM SULPHURIC ACID MEDIUM WITH TRIOCTYLAMINE, AND ITS REACTION IN THE EXTRACT WITH SEVERAL ORGANIC REAGENTS. Ponomareva, A. A. Tr. Novocherkassk. Politekh. Inst.; No. 266, 103-110(1972). (In Russian).

The possible mechanism of extraction of Mo(VI) and accompanying elements (V, Fe, Cr, and Zr) by trioctylamine solution in toluene is discussed. From media of pH 0.5 to 2, almost 100% of the Mo is extracted. The optimum acidity ranges (or pH values) and the percentages of the other metals extracted are Cr(VI), 3N-H_2SO_4 to pH 2, 95%; Zr, 2N-H_2SO_4 to pH 1.7, 100%; V(V), pH ≃1, ≃50%; Fe(III), pH ≃3, ≃25%. The possibility of separating Mo from V(IV), Fe, and Cr(II) is shown. For the subsequent photometric determination of Mo, 52 reagents of the o-dihydroxy-type were tested. The best sensitivity and the greatest contrast of the color reaction were obtained with phenylfluorone, p-dimethylaminophenylfluorone, catechol violet, pyrogallol red and bromopyrogallol red. The spectrophotometric properties of these reagents and of their metal complexes are given. (Ref. Zh.)

24147 DETERMINATION OF TITANIUM AND THORIUM IN BONE TISSUES. Mal'tseva, M. M. (Inst. of Hygiene and Occupational Disease, Moscow). Gig. Sanit.; No. 7, 89-91(Jul 1973). (In Russian).

A method is described for determining titanium and thorium in bone tissue when present together. Titanium is determined colorimetrically using diantipyrylmethane with a solution of the bone ash residue. Thorium is determined with Arsenazo III after separation from impurities and coprecipitation with calcium oxalate followed by separation from excess calcium by cation exchange. The minimum amounts detected in 3 g of bone are 0.5 μg of titanium with an error of 14% and 0.4 μg of thorium with an error of 30%. Elements naturally occurring in bone—Ca^{3+}, PO_4^{3-}, F^-, etc.—do not interfere. (MG)

24148 HETEROGENEOUS OXIDATION AND REDUCTION PROCESSES: MECHANISMS AND ANALYTICAL APPLICATIONS. Pickering, W. F. (Dalhousie Univ., Halifax, Nova Scotia). CRC Crit. Rev. Anal. Chem.; 3: No. 3, 271-298 (Aug 1973).

Basic processes in heterogeneous reactions are reviewed. Topics discussed are: surface reactions; nucleation and growth processes; mass transport; temperature effects; and experimental artifacts. Analytical applications considered include gas–solid systems; solute–solid interactions; selective reduction systems; and dissolution procedures involving chemical oxidation and reduction. (DHM)

Radiometric and Radiochemical Procedures

Refer also to abstracts 24320, 24569, 24592, 24616, 24854–24856, and 25199.

24149 (CEA-CONF-2248) USE OF X-RAY FLUORESCENCE AND EMISSION AND ABSORPTION SPECTROGRAPHY TO MEET THE ANALYTICAL REQUIREMENTS OF URANIUM PROCESSING PLANTS. Heres, A.; de Murcia, A. (Commissariat a l'Energie Atomique, Fontenay-Aux-Roses (France). Centre d'Etudes Nucleaires). 1972. 16p. (In French). (CONF-7210104-1). Dep. NTIS (U. S. Sales Only) $3.00.

From 9th international symposium on material analysis; Toulouse, France (2 Oct 1972).

Nonirradiated uranium samples are analyzed without the use of biological shielding. X-ray fluorescence analysis is used essentially for the determination of the uranium contents of concentrated solutions and rejected effluents. Atomic absorption techniques are superior to calorimetric methods for the rapid evaluation of large numbers of metallic impurities (Ag, Cd, Co, Cr, Cu, Fe, Mn, Ni, Pb, Zn, alkali metal, and alkaline earth metals). Because it permits the simultaneous determination of a large number of elements in the trace state (Al, As, B, Ba, Be, Bi, Ca, Cd, Co, Cr, Cu, Fe, Li, Mg, Mn, Mo, Na, Ni, Pb, Si, Sn, Ti, Zn, Zr, V), emission spectrography is the most suitable method for verifying whether the finished products conform with the specifications. (FR)

24150 (CEA-R-4436) USE OF THE FILAMENT TECHNIQUE IN ATOMIC ABSORPTION SPECTROPHOTOMETRY FOR DETERMINING TRACES OF ELEMENTS. Hircq, B. (Commissariat a l'Energie Atomique, Bruyeres-le-Chatel (France). Centre d'Etudes). Aug 1973. 37p. (In French). Dep. NTIS (U. S. Sales Only) $4.00.

A description of the absorption cell is given. The principal parameters are then studied: argon flow in the cell, temperature of the filament serving as the atomization source, geometry of the cell, and the nature of the filament. The technique was applied to the determination of impurities in U after its deposition on a C filament. The reproducibility of the method was also studied. (auth)

24151 (IAEA-R-880-F) CHROMATOGRAPHIC SEPARATION OF URANIUM AND PLUTONIUM FROM REPROCESSING PLANT LIQUID WASTE FOLLOWED BY AUTOMATIC MEASUREMENT OF PLUTONIUM AMOUNTS BY PROBE TYPE ALPHA DETECTOR AND THE URANIUM BY PHOTOMETRY METHODS. Final Report, December 15, 1969–December 14, 1971. Markov, V. (International Atomic Energy Agency, Vienna (Austria)). Jan 1972. 59p. (In Russian). INIS.

Adsorption chromatography involving reversed phase partition columns was found to be the most promising method for analysis of the liquid waste occurring in reprocessing plants. The theoretical principles of extraction chromatography and the results of experiments were applied during the development of methods for the determination of uranium and plutonium in waste solutions. The equations derived from the plutonium(IV) partition isotherm and the dynamic activity of the trioctylamine sorbent enable the calculation of the sorbent layer dimensions and the extractant amounts which will ensure the complete plutonium extraction. The sorbent layer consists of finely ground solid carrier (fluoroplast) the surface of which is coated with a thin film of extractant. The eluent (a 1.5 M nitric acid solution containing ~3 wt % of ammonium oxalate) is very effective. The amount of plutonium is determined by direct measurement of the alpha activity of eluate with a silicon alpha detector. A concentration of $^{239}Pu > 1$ mg/l is found with a variation coefficient $v \sim 3\%$. The duration of the analysis is 20 to 30 minutes. Two methods were developed for determining uranium. The first is based on the simultaneous extraction and separation of uranium and plutonium by means of a two stage chromatographic extraction column. The second method is based on the chromatographic extraction of uranium by a thin film of extractant (5% TBP in CCl_4). The uranium is re-extracted by ammonium carbonate solution and determined by luminescence method; alternatively it is re-extracted by arsenazo III solution and then determined photometrically. The sensitivity of photometric determination is 2.5 μg; the variation coefficient of the determination >100 μg/ml ~ 2%. (INIS)

24152 (LA-5347-SR) ANALYTICAL METHODS FOR FISSIONABLE MATERIALS IN THE NUCLEAR FUEL CYCLE. Program Status Report, June 1972-June 1973. Waterbury, G. R. (comp.) (Los Alamos Scientific Lab., N. MEX). Aug 1973. Contract W-7405-eng-36. 10p. Dep. NTIS $4.00.

Progress was made on the development of methods for the dissolution of materials and the determination of plutonium and uranium for nuclear safeguards application, the preparation of well-characterized plutonium-containing materials as SALE samples and as NBS standards, and the analysis of special inventory-surveillance materials. The Teflon-container, metal-bomb apparatus for the acid dissolution of samples at temperatures to 280°C and pressures to 5000 psi was used in dissolution of the HTGR-fuel, made of microspheres of U–Th carbide with coatings of pyrolytic carbon and silicon carbide. A pressure venting mechanism is being added to this apparatus. Conditions have been established for a γ assay of ^{235}U in uranium–thorium mixtures. An automated spectrophotometer has been built and applied to the analysis both of plutonium and uranium. An advanced model of this instrument

is nearing completion. Well-characterized uranium-plutonium mixed oxide pellets and powders and plutonium dioxide powders were prepared for the SALE Program. A second series of plutonium nitrate solution materials is nearing completion. Five hundred highly pure plutonium metal standards were prepared for NBS. Several special samples were analyzed for inventory-surveillance purposes. (auth)

24153 (LA-tr-73-39) DETERMINATION OF URINARY PLUTONIUM BY RADIOCHEMICAL ANALYSIS ON ION EXCHANGE FILTERS. Clanet, F.; Ballada, J.; Lucas, J.; Gil, C. Translated from Health Phys.; 23: 245-247(1972). 6p. Dep. NTIS $3.00.

Background studies and a recommended method are described for determining Pu in urine, which involves separation of Pu(IV) on an HAWP Millipore filter supporting three Amberlite SB-2 ion exchange filter papers. The detection limit claimed is 1 PCi ^{239}Pu/liter of urine. There is excellent agreement between the results of this method and the standard one involving separation of Pu on an ion exchange column, but the described method is far quicker. (UK)

24154 (SSI-1973-10) FAST METHOD FOR ANALYSIS OF STRONTIUM-89, STRONTIUM-90, AND YTTRIUM-90 ESPECIALLY IN MILK. Suomela, J. (National Inst. of Radiation Protection, Stockholm (Sweden)). Mar 1973. 10p. (In Swedish). Dep. NTIS (U. S. Sales Only) $3.00.

A procedure of chemical analysis of yttrium and strontium is described. Yttrium-90, ^{89}Sr and ^{90}Sr are separated from other substances. Measurements are made on yttrium and strontium separately. From the results of these measurements the concentrations are calculated. When the method was tested it appeared to be fast and simple. The maximum errors were below 20%, and the time used was 4 hours. (Sweden)

24155 DETECTION OF HARD β-EMITTING RADIONUCLIDES IN AQUEOUS SOLUTIONS USING CHERENKOV RADIATION: A REVIEW ARTICLE. Francois, B. (Hopital de l'Antiquaille, Lyon). Int. J. Nucl. Med. Biol.; 1: No. 1, 1-14(Jan 1973).

Cherenkov counting of solutions is advocated as a useful means of detecting hard β-emitters; in this study the practical aspects of Cherenkov detection with commercially available liquid scintillation spectrometers are considered. The variations of count rates with the type of vials and the volume of solutions are pointed out. With a spectrometer equipped with S 11 phototubes, detection efficiencies from 16 calibrated sources were found to be 23 to 50 per cent for emitters of E_β maximum in the range 1.3 to 2.3 MeV and 50 to 70 per cent up to 3.5 MeV. The results of experiments with various optical filters suggest a direct relationship between the β energy of the isotope and the fraction of Cherenkov light emitted in the uv region. Pulse height analysis either by calculation of the channel ratio obtained from the spectrometer or by direct oscilloscopic display of spectra enables the energy of any unknown β-emitter to be evaluated. Color quenching of biological solutions inhibits more widespread use of Cherenkov counting while solute quenching is shown not to be a problem. Changes induced by 31 wavelength shifters are assessed; Esculin is singled out as one of the most effective. Stress is being put on the advantages of Cherenkov counting of ^{42}K, ^{32}P, ^{86}Rb, and ^{24}Na and the applicability of the method to more than 40 β-emitters having maximum beta energies above 1 MeV. (auth)

24156 DETERMINATION OF PRECIPITATION OF RADIOIODINE IN THE RADIOLOGICAL EXAMINATION OF CONTAMINATED SURFACE WATERS. Haschke, J. (Hygienisches Inst. der Freien und Hansestadt, Hamburg). Staedtehygiene; 23: No. 11, 260-265(1972). (In German).

Increases of the radioactivity level in rivers can be caused by radioiodine. The radiological examination of such water samples by routine methods showed correct results only when radioiodine was precipitated. Iodine carrier and silver ions are added simply and safely to water samples before their preparation for analysis. The addition of iodine carrier can be omitted if the water contains enough chlorides. Methods used at river water testing stations are examined as to their efficiency regarding the precipitation of radioiodine, and the results are given. (GE)

24157 DETERMINATION OF TRITIUM DISTRIBUTION IN ENVIRONMENTAL AND BIOLOGICAL SAMPLES. Bogen, D. C.; Henkel, C. A.; White, C. G. C.; Welford, G. A. (Health and Safety Lab., AEC, New York). J. Radioanal. Chem.; 13: No. 2, 335-341 (Feb 1973).

A method for the determination of the tritium distribution in environmental and biological samples is described. Tritium as HTO is removed by freeze-drying and the residue is combusted to obtain organically bound tritium. Each tritium fraction is electrolytically enriched and determined by liquid scintillation spectrometry. Enrichment and large sample sizes are required due to the low environmental tritium levels. During the analyses of more than 600 samples over a two-year period all aspects of the method (freeze-drying, combustion, enrichment and counting) have provided reproducible and precise results. (auth)

24158 ACCURATE DETERMINATION OF COPPER IN MIXTURES AND ORES BY RADIOISOTOPE-EXCITED X-RAY FLUORESCENCE SPECTROMETRIC ANALYSIS USING PEAK RATIOS. Shenberg, C.; Haim, A. B.; Amiel, S. (Soreq Nuclear Research Centre, Yavne, Israel). Anal. Chem.; 45: No. 11, 1804-1808(Sep 1973).

In a solution containing a single predominant element, the ratio of an x-ray fluorescent line to a target backscattered line varies linearly with the concentration of the element over a wide range. However, the presence of an additional component of lower Z distorts the proportionality. This work shows that accurate analysis can be carried out in mixtures by suitable treatment of the data. A rough estimate of the lower Z component was obtained by the usual peak ratio method. The ratio of its fluorescent line to the target backscattered line was largely independent of the concentration of the higher Z component. This fact and a comparison of mixture solutions of various concentrations with single-element solutions of similar concentrations permitted correction for the distortion introduced by the presence of the lower Z element. The case studied was the mutual influence of Cu and Fe on the ratio between the fluorescent K x-rays of the individual elements and the backscattered target x-rays in various Cu–Fe mixtures. The x-rays were excited using an ^{241}Am–As source-target assembly and measured with a Si(Li) detector. Using the new method of calculation, satisfactory analytical results were obtained for solutions of 0.6 to 25 w/v% Cu in the presence of 0.4 to 23 w/v% Fe. The procedure was extended to solid mixtures and ores containing up to 80% Cu. (auth)

24159 TEST OF X-RAY FLUORESCENCE SPECTROMETRY AS A METHOD FOR ANALYSIS OF THE ELEMENTAL COMPOSITION OF ATMOSPHERIC AEROSOLS. Hammerle, R. H. (Ford Motor Co., Dearborn, MI); Marsh, R. H.; Rengan, K.; Giauque, R. D.; Jaklevic, J. M. Anal. Chem.; 45: No. 11, 1939-1940(Sep 1973).

In an effort to determine if x-ray fluorescence analysis with a semiconductor detector is sufficiently sensitive and accurate to analyze atmospheric particulate matter, a comparison was made of the results obtained by x-ray fluorescence and the results obtained from the same samples by neutron activation and, for Pb, by atomic absorption. For comparison 10 elements (Ca, Ti, Cr, Mn, Fe, Ni, Cu, Zn, Br, and Pb) were determined. The two methods of analysis generally agree within 20%. It is concluded that x-ray fluorescence analysis with a semiconductor detector is accurate and sensitive enough for the analysis of atmospheric particulate matter. (DHM)

24160 PLANT TRIALS OF RADIOISOTOPE IMMERSION PROBES FOR ON-STEAM ANALYSIS OF MINERAL PROCESS STREAMS. Fookes, R. A.; Gravitis, V. L.; Hinckfuss, D. A.; Stump, N. W.; Watt, J. S. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Inst. Mining. Met., Trans., Sect. C; 82: No. 796, C21-C25(Mar 1973).

Radioisotope x-ray techniques for the on-stream determination of zinc and lead were tested at the plant of New Broken Hill Consolidated, Ltd., Australia. Zinc concentrations were measured by x-ray fluorescence techniques using a ^{238}Pu radioisotope source to irradiate the pulp with x-rays of energy 13 to 20 keV. Lead is determined by measurement of the absorption of 100-keV ^{153}Gd gamma-rays by the pulp. The fluorescence probes were immersed directly into plant pulp streams, thereby overcoming the need to sample the stream. Zinc was determined to 2 per cent of its mean concentration in the flotation feed and zinc rougher tailing streams, and 6 per cent in the residue. Lead was determined to 5 per cent in the flotation feed and 6 per cent in the residue. The accuracies obtained are considered to be sufficient for the purpose of mill control. (auth)

24161 NEW METHOD FOR THE ANALYSIS OF RADIOACTIVELY LABELLED COMPOUNDS. Mukherjee, K. D. (Bundesanstalt fuer Fettforschung, Muenster, Ger.); Mangold, H. K. J. Chromatogr.; 82: No. 1, 121-124(18 Jul 1973).

A new scanner for quantitative thin-layer chromatography can be employed for the measurement of radioactive fractions. Using this instrument, one can assess both the chemical and the radioactive purity of labeled substances. Moreover, it is possible to determine the specific activity of pure labeled compounds. (auth)

24162 USE OF THE SPARK-CHAMBER RADIO-SCANNER FOR RAPID LOCATION AND QUANTITATION OF LABELLED COMPOUNDS AFTER ONE- AND TWO-WAY SEPARATIONS.

Smith, I.; March, S. E.; Mullen, P. E.; Mitchell, P. D. (Middlesex Hospital Medical School, London). J. Chromatogr.; 82: No. 1, 75-83(18 Jul 1973).

A rapid method of scanning two-way radio-chromatographic and electrophoretic separations is described. The scanner produces a photograph in approximately 10 min, which is adequate for almost all uses and compares well with the usual 4- to 20-week x-ray film method. The technique is illustrated with examples from tyramine metabolism. (auth)

24163 APPLICATION OF CHARACTERISTIC SECONDARY ION MASS SPECTRA TO A DEPTH ANALYSIS OF COPPER OXIDE ON COPPER. Werner, H. W.; Grefte, H. A. M. D.; Berg, J. V. D. (Philips Gloeilampenfabrieken NV, Eindhoven, Netherlands). Radiat. Eff.; 18: No. 3-4, 269-273(1973).

The study of molecular and cluster ions in secondary ion-mass spectrometry has led to the concept of characteristic (fingerprint) spectra for this mode of ionization. Thin films of copper oxide with decreasing oxygen concentration as a function of depth were investigated. The dependence of all mass peaks as a function of depth can be calculated from the measured values of just one peak by means of a linear superposition of the characteristic mass spectra of copper oxide and copper. Finally it is shown that the concentration of copper and copper oxide as a function of depth can be calculated from any mass peak when using the appropriate fingerprint spectra. (auth)

24164 GOLD DETERMINATION IN ROCKS AND ORES BY THE ISOTOPE DILUTION WITH THE SUBSTOICHIOMETRIC EXTRACTION OF GOLD WITH DIOCTYLSULFIDE. Gil'bert, E. N.; Glukhov, G. G.; Larionova, L. A.; Mikhailov, V. A. (Inst. of Inorganic Chemistry, Novosibirsk, USSR). Izv. Sib. Otd. Akad. Nauk SSSR, Ser. Khim. Nauk; No. 3, 85-87(May 1973). (In Russian).

The determination of small amounts of gold in rocks and ores by isotope dilution followed by substoichiometric extraction of gold with organic sulfides is reported. Sensitivity of the method is 5×10^{-10} grams of Au per gram. (auth)

24165 EFFICIENCY DATA FOR SOME BETA EMITTER SOURCES IN DEFINITE CHEMICAL FORM VERSUS THICKNESS. Battaglia, A.; Bonfanti, G.; Triulzi, C. (Centro Informazioni Studi Esperienze, Milan). J. Radioanal. Chem.; 13: No. 2, 483-496(Feb 1973).

Beta detection efficiency curves are reported for some radionuclides of interest (^{40}K, ^{90}Y, ^{90}Sr + ^{90}Y, ^{137}Cs, ^{144}Ce + ^{144}Pr, ^{147}Pm, ^{155}Eu and ^{204}Tl) contained in sources of a suitable material and having a superficial density ranging from 3 to 110 mg/cm^2; the curves were experimentally drawn by measuring the reference sources in different geometries by means of three GM window detectors (one of them with low background) and of a 2π flow proportional counter. These curves have been used for several years to determine radionuclides in sources of different thickness obtained by specific radiochemical separations from various environmental samples. (auth)

24166 ENERGY DISPERSIVE X-RAY EMISSION SPECTROMETRY FOR MULTIELEMENT ANALYSIS OF AIR PARTICULATES. Rhodes, J. R.; Pradzynski, A. H.; Sieberg, R. D. (Columbia Scientific Industries, Austin, TX). Anal. Instrum.; 10: 143-150(1972).

From 18th annual ISA analysis instrumentation symposium; San Francisco, California, USA (3 May 1972). See CONF-720596-.

X-ray fluorescence analysis using radioisotope sources for excitation, a Si(Li) detector for energy dispersive spectrometry, and a minicomputer for data reduction and automatic instrument control, was applied to determining the "heavy element" constituents (Ca, Ti, V, Cr, Mn, Fe, Co, Ni, Cu, Zn, Hg, Pb, As, Br, Sr, Zr and Mo) of air particulates collected on filter paper. A statewide survey was performed comprising collection of 89 samples at some 40 stations in Texas, and determination of 17 elements per sample. For comparison parallel measurements were made on 12 of the samples using atomic absorption spectrophotometry. Satisfactory sensitivity for all elements measured by x-ray fluorescence was obtained by direct analysis of the filter paper, thus avoiding sample preparation and wet chemistry. This, coupled with the multielement, non-destructive nature of the technique has enabled significant reductions to be made in the cost and time of analysis. As a result, more extensive and revealing air particulate surveys should be possible, with consequent improvements in the discovery and positive identification of particulate pollution sources. (auth)

24167 ELEMENTAL ANALYSIS BY PROTON AND X-RAY INDUCED CHARACTERISTIC X-RAYS. Rudelph, H.; Kliwer, J. K.; Kraushaar, J. J.; Ristinen, R. A.; Smythe, W. R. (Univ. of Colorado, Boulder). Anal. Instrum.; 10: 151-156(1972).

From 18th annual ISA analysis instrumentation symposium; San Francisco, California, USA (3 May 1972). See CONF-720596-.

The detection of characteristic x-rays induced by either proton or x-ray bombardment of submilligram samples has proved to be a sensitive and broad-range tool for elemental analysis. In general, concentrations as low as 1 ppM of the target material may be observed for atomic numbers between 14 and 56. Very heavy elements such as lead may be studied with somewhat decreased sensitivity. Concerns arising from matrix effects and their relation to the sensitivity of the method are discussed. As specific examples of applications, investigations concerning blood dialysis of patients who have lost kidney function and the transport and biological impact of certain trace metals (molybdenum) in the environment are presented. (auth)

24168 X-RAY FLUORESCENCE ANALYTICAL CONTENT DETERMINATION OF CARBIDE MIXTURES. Scharz, W. (Gebr. Boehler and Co. AG, Kapfenberg, Austria). pp 385-389 of Application of Different Spectroscopic Methods to the Solution of Problems in Chemical Analysis. London; Adam Hilger Ltd. (1972). (In German).

From 16th international conference on spectroscopy; Heidelberg, Federal Republic of Germany (4 Oct 1971). See CONF-711015-(V1 and V2).

Alloy powders for sintered carbides can be investigated economically as to their composition by means of x-ray fluorescence analysis. The direct analysis of the mixtures, however, contains errors on account of the fact that the particle size and their distribution as well as the interelemental effect influence to a great extent the secondary x-ray emission. The matrix effects can be avoided if the samples are dissolved in alkaline solvents and if a neutral element possessing a high mass absorption coefficient is added. In this manner, for the various elements, generally applicable calibration functions which guarantee a linear connection between the intensity of the radiation and the content of the alloying element over a wide range and devoid of interelemental effects, are obtained in their x-ray fluorescence analysis. Thus, the measurements can be effected in a simple manner by means of the impulse ratio of the sample to that of a reference sample with the application of calibration curves or functions. With due consideration of the practical requirements, the range of application of the method lies between the following limits: W-45 to 95%; Co-0.05 to 50%; Ta-0.05 to 5%; Nb-0.05 to 5%; Ti-0.30 to 16%; Mo-0.06 to 4%; V-0.15-4%; and Ni-0.04 to 4%. (auth)

24169 DIRECT METHOD FOR EVALUATING PLUTONIUM-239 AND AMERICIUM-241 CONTENT IN LARGE SOIL SAMPLES. Piltingsrud, H. V.; Stencel, J. R. (Air Force Radiological Health Lab., Wright-Patterson AFB, OH). Health Phys.; 25: No. 4, 448-450(Oct 1973).

The method for soil sample analysis is described that requires only placing the sample in a standardized container and directly counting the sample, detecting the low-energy x-gamma radiations emitted by the sample. This method also permits direct analysis of large samples (up to 1 kg), causing relatively low errors due to inhomogeneities in the samples. The electronic equipment used with this procedure is described. Experience with this system has demonstrated it to be a reliable and rapid method for analysis of low to medium specific activity samples (sample ^{239}Pu + ^{241}Am specific activity >20 pCi/g). It is felt that this data treatment technique should also have a direct application to the determination of lung burdens of plutonium when a phoswich type of detection system is used. (UK)

24170 EMANATION METHOD FOR DETERMINING RADIUM USING LIQUID SCINTILLATION COUNTING. Darrall, K. G.; Richardson, P. J.; Tyler, J. F. C. (Dept. of Trade and Industry, London). Analyst; 98: No. 1169, 610-615(Aug 1973).

A very simple emanation method for determining radium is described. Radon is adsorbed on silica gel at the temperature of liquid nitrogen and the silica gel is transferred at 0°C to a toluene-based liquid scintillator for counting in an automatic liquid scintillation spectrometer. The lowest limit of detection is 0.1 pCi of radon. (auth)

24171 VARIATION IN TRACE METAL CONCENTRATIONS ALONG SINGLE HAIRS AS MEASURED BY PROTON-INDUCED X-RAY EMISSION PHOTOMETRY. Valkovic, V.; Miljanic, D.; Wheeler, R. M.; Liebert, R. B.; Zabel, T.; Phillips, G. C. (Rice Univ., Houston, TX). Nature (London); 243: No. 5409, 543-544 (29 Jun 1973).

A single hair from a female head was cut into 14 pieces, approximately 3 cm in length, and the pieces were exposed to the beam of 3-MeV protons from the Rice University tandem Van de Graaff accelerator. Detector efficiency for elements lighter than Ca and the low energy bremsstrahlung background was reduced by introducing a polystyrene absorber in front of the detector. The resulting x-rays were detected by a Si(Li) detector and amplified, then processed and stripped for peak intensity by

an IBM 1800 computer. The x-ray spectrum obtained for one of the samples is shown. Peaks associated with Ca, Ti, Fe, Cu, Zn, Pb, Br, and SrKα and Kβ x-ray lines were present in all spectra. Results showed that the concentrations of trace elements undergo large fluctuations in close proximity to the scalp, and the relative concentrations of Ca, Sr, Cu, Fe, Br, and Zn change significantly with distance along the hair. The source of these variations may be associated with the environmental and biomedical history of the hair and its owner. (UK)

24172 X-RAY SPECTROMETRIC DETERMINATION OF IRON-55 IN AERIAL DUST AND PRECIPITATION SAMPLES. Winkler, R. (Gesellschaft fuer Strahlen- und Umweltforschung mbH, Nuremberg. (1973). vp. (In German).

From conference of the Gesellschaft Deutscher Chemiker on trace analysis; Heidelberg, Germany (2 Apr 1973).

Iron-55 was determined in monthly collected air filter and deposition samples since March 1970 and January 1971. After washing, iron was separated by extraction with diisopropyl ether. Further, interfering fallout radionuclides were removed by an ion exchange step. Finally, iron was electrodeposited on a copper disk and the x-ray spectrum was measured using a proportional counter or a Si(Li) detector. Average activity concentration in the air was found to be 1.0 fCi per m^3 in 1970 (since March), 1.2 fCi per m^3 in 1971 and 0.36 fCi per m^3 in 1972. The annual deposition to the ground was 697 pCi per m^2 and year in 1971 and 178 pCi per m^2 and year in 1972. (auth)

24173 LIQUID SCINTILLATION ASSAY OF IRON-55 AND IRON-59 IN WHOLE BLOOD SAMPLES. Wagner, A. (Institut d'Hematologie, Montpellier, France). Int. J. Appl. Radiat. Isotop.; 24: No. 9, 548-550(Sep 1973).

A simple method of radioassay of ^{55}Fe and ^{59}Fe is described. Samples of whole blood are prepared for counting in a liquid scintillation procedure. The method is simple and the counting efficiency reaches 11.2% for ^{55}Fe and 83.7% for ^{59}Fe. The simplicity of the procedure may allow routine uses for the study of iron absorption and ferrokinetics in patients by means of the double tracer method. It is advisable to seek a technique of incorporation of ^{55}Fe in the scintillator solution with less quenching than that encountered in the present procedure. (UK)

24174 AUTOMATED COMBUSTION FOR ROUTINE SAMPLE PREPARATION IN LIQUID SCINTILLATION SPECTROMETRY. Rapkin, E.; Reich, A. CZ-Chem.-Tech.; 1: No. 9, 439-443(1972). (In German).

Preparation techniques are discussed, and the Peterson catalytic-combustion method is described in detail. An automatic commercial apparatus based on this combustion principle is also described, in which ^{14}C and ^{3}H are measured by liquid scintillation counting after conversion into $^{14}CO_2$ and $^{3}H_2O$, respectively. (Anal. Abstr.)

Separation Procedures

Refer also to abstracts 24527, 25071, 26861, 26886, and 26887.

24175 SOLVENT EXTRACTION PROCESS FOR THE RECOVERY OF MOLYBDENUM AND RHENIUM FROM MOLYBDENITE. Peterson, H. D. (to Molybdenum Corp. of America). U. S. Patent 3,751,555. 7 Aug 1973. Filed date 22 Mar 1972. 10p.

A solvent extraction process is described for recovery of Mo and Re from highly acid solutions using alkyl phosphonate and organophosphoric acid as extractants. The process is applicable to the recovery of Mo and Re from leach solutions having a sulfuric acid content up to 600 g/l resulting from nitric acid–oxidation leach of molybdenite. (DHM)

24176 DISTRIBUTION OF URANIUM(IV) BETWEEN AQUEOUS NITRIC ACID AND SOLUTIONS OF NITRATE SALTS OF THE PRIMARY AMINE PRIMINE JM-T. Schmid, E. R.; Juenger, E. (Univ., Vienna). J. Radioanal. Chem.; 13: No. 2, 349-362(Feb 1973). (In German).

The distribution of uranium(IV) between aqueous nitric acid solutions and solutions of the nitrate salt of the primary amine Primene JM-T in various diluents is described. The influence of the concentration of the acid, nitrate, and perchlorate in the aqueous phase was studied, taking into account the complex composition of uranium(IV) in the aqueous phase and the acid content of the organic phase. The uranium(IV) extraction may be explained by the competition between metal complex and nitric acid for the extracting agent. The absorption spectra of the organic phase and the results of maximum loading experiments indicate that the uranium(IV) species in the organic phase is the bis-alkylammonium-hexanitrato-uranium(IV) complex $[(RNH_3)_2U(NO_3)_6]$. (auth)

24177 SYNTHESIS AND ION-EXCHANGE PROPERTIES OF ZIRCONIUM FERROCYANIDE. Separation of Zn^{2+} from Cd^{2+}, Mn^{2+}, and Co^{2+}; UO_2^{2+} from Th^{4+} and Zr^{4+}; and Ca^{2+} from Ba^{2+}. Gill, J. S.; Tandon, S. N. (Univ. of Roorkee, India). J. Radioanal. Chem.; 13: No. 2, 391-399(Feb 1973).

Samples of zirconium ferrocyanide were prepared under different conditions of precipitation, and their properties, composition, and ion-exchange behavior are reported. The distribution ratios of 21 metal ions are given. Some topical separations were achieved using these data. (auth)

24178 SYNTHESIS OF A REPRODUCIBLE AND CHEMICALLY STABLE TANTALUM ANTIMONATE. Quantitative Separation of $VO^{2+}-Al^{3+}-Ti^{4+}$, $VO^{2+}-Fe^{3+}-Ti^{4+}$, AND $UO_2^{2+}-Ti^{4+}$. Qureshi, M.; Gupta, J. P.; Sharma, V. (Aligarh Muslim Univ., India). Anal. Chem.; 45: No. 11, 1901-1906(Sep 1973).

A new ion exchanger, tantalum antimonate (Sb/Ta = 1.3), was synthesized by mixing 0.1 M tantalum and antimony pentachloride solution in the ratio 1:2 at room temperature. The pH of the mixture was adjusted to 1 with ammonia. The precipitate obtained was refluxed with mother liquor for 16 hr. This procedure gave a reproducible ion exchanger. Molar distribution coefficients for 27 metal ions were determined on this gel at pH 0, 1, 2, 3, 4, and 5. The following mixtures have been separated: (1) $VO^{2+}-Fe^{3+}-Ti^{4+}$, (2) $VO^{2+}-Al^{3+}-Ti^{4+}$, (3) $UO_2^{2+}-Ti^{4+}$. UO_2^{2+} and VO^{2+} were removed with 0.1 M nitric acid, Fe^{3+} with 1.0 M nitric acid, Al^{3+} with 1.0 M hydrochloric acid, and Ti^{4+} with 2 N sulfuric acid plus 3% H_2O_2 (9:1). (auth)

24179 EXTRACTION OF TRIVALENT LANTHANIDES. I. Cations by Diphenylphosphinic Acid. de Almeida, I. G.; Palino, G. F. (Instituto de Engenharia Nuclear, Rio de Janeiro). Radiochem. Radioanal. Lett.; 14: No. 5-6, 323-331(5 Sep 1973).

The distribution of trivalent lanthanides between solutions of diphenylphosphinic acid (ϕ)$_2$PO(OH), in chloroform and aqueous nitric acid phases was investigated radiometrically. The distribution ratio, D, was studied as a function of the mineral acid concentration in the aqueous phase, the atomic number of the lanthanide and the temperature, for all lanthanides except Pm. The plot of log D vs. Z is in accord with the tetrad or double-double effect hypothesis put forward for the lanthanides and actinides. Because of the large distribution coefficients and separation factors obtained, diphenylphosphinic acid appears to be one of the most promising reagents for the extraction and separation of small quantities or trivalent lanthanides. (auth)

24180 SYNERGISTIC EXTRACTION OF URANYL COMPLEXES WITH TTA–TBPO MIXTURES INTO VARIOUS SOLVENTS. Akiba, K. (Tohoku Univ., Sendai). J. Inorg. Nucl. Chem.; 35: No. 9, 3323-3332(Sep 1973).

The synergistic effect in the extraction of uranyl complexes with a mixture of thenoyltrifluoroacetone (TTA) and tributyl phosphine oxide (TBPO) was studied by using the ^{237}U tracer. The synergistic complex in this system was found to be $UO_2A_2 \cdot S$ (A: TTA anion; S: TBPO), whereas no higher adducts such as $UO_2A_2 \cdot mS$ (m > 1) were observed. The extraction constants ($K_{ex,S}$) and the adduct formation constants (K_S) were determined in twelve organic solvents. These equilibrium constants depend on the kind of solvent used, e.g., log K_S = 7.00 in methylene chloride and 9.18 in cyclohexane. The sequence of the log K_S values in different solvents is similar to that for TBP adduct of UO_2A_2. The regularity in the adduct formation constants is discussed. (auth)

24181 SOLVENT EXTRACTION OF URANIUM(IV). 2. Extraction of Uranium(IV) by Di-2-Ethylhexyl Phosphoric Acid from Hydrochloric Acid Solutions. Kiwan, A. M.; Amin, R. S. (National Research Centre, Cairo). J. Inorg. Nucl. Chem.; 35: No. 9, 3315-3321(Sep 1973).

The distribution of uranium(IV) between hydrochloric acid solutions and solutions of di-(2-ethylhexyl) phosphoric acid (HDEHPA) in carbon tetrachloride was investigated at different concentrations of hydrochloric acid, extractant, and uranium. In moderately acidic solutions (C_{HCl} < 2.7M) uranium(IV) is extracted as $U(DEHPA)_4$ and from more acidic solutions (C_{HCl} 2.7 to 7.0M), as the mixed complex $UCl_2(DEHPA)_2$. At still higher HCl concentrations, viz., C_{HCl} > 7.0M, there is an evidence of a solvation mechanism involving the extraction of solvated uranium complexes. The ir absorption spectra of uranium(IV) complexes in CCl_4 are also recorded and discussed. (auth)

24182 EFFECT OF ARSENIC TRICHLORIDE ON SOLVENT EXTRACTION OF SOME ELEMENTS FORMING COMPLEX METALLO-ACIDS. Kuz'min, N. M.; Vlasov, V. S.; Bokova, T. A. Zh. Anal. Khim.; 28: No. 6, 1218-1221(Jun 1973). (In Russian).

Some theoretical grounds for the effects of $AsCl_3$ on the solvent extraction of elements forming complex metallo-acids are considered. It was found by experiments on the extraction of Sn(IV), In, Au(III), Ga, Te(IV), Se(IV), and Fe(III) that the effect of $AsCl_3$

is minimum in the n-decyl alcohol–hydrochloric acid system. (auth)

24183 SOLVENT EXTRACTION OF THALLIUM AND ITS SEPARATION FROM ACCOMPANYING METALS. Determination of Thallium in Products of Lead–Zinc Production. Varentsova, V. I.; Rodina, T. F.; Levin, I. S. (Inst. of Physical Chemical Principles of Treatment of Mineral Raw Materials, Novosibirsk, USSR). Zh. Anal. Khim.; 28: No. 6, 1086-1089(Jun 1973). (In Russian).

Thallium(I) can be separated from large amounts of alkali, alkaline earth, and rare earth metals, Cr(III), Ga, Al, Tl(IV), Zr, Mn(II), Zn, Ni, Sb(III), Ag, Fe(II), Fe(III), Hg(II), and As(III) by extraction using bis(2-ethylhexyl) phosphoric acid (D2EHPA) from acidic media and back extraction using 9N HNO_3 or a $CuSO_4$ solution. A method was developed for separation of Tl(I) in its determination in solutions of lead–zinc production.

24184 PHOTOLYTIC SEPARATION OF URANIUM FROM LANTHANUM AND CERIUM. Das, C. R.; Patnaik, D. (Ravenshaw Coll., Cuttack, India). Chem. Ind. (London); No. 14, 699 (21 Jul 1973).

It was found that when a uranyl sulphate solution containing La or Ce sulphate, together with alcohol and a small amount of formic acid, is exposed to sunlight, an hydrated sulphate is readily precipitated. Details are given of the experimental work. With different mixtures of U and La sulphate, and with the percentage of alcohol varying between 20 and 50, the yield corresponded to between 92.1 and 99.1% of the U present, and the purity was 99.05 to 99.90%. With Ce sulphate the yield was 98.3 to 99.8% and the purity 99.20 to 99.40%. It was observed that the proportion of alcohol and the pH affected the percentage recovery of U; at 50% alcohol the yield was 99% and the purity good. (UK)

24185 PLACE OF SULFOXIDES AND SULFIDES IN NEUTRAL EXTRACTANTS SERIES AND THEIR POSSIBLE APPLICATIONS. Mikhailov, V. A.; Torgov, V. G.; Nikolaev, A. V. (Inst. of Inorganic Chemistry, Novosibirsk, USSR). Izv. Sib. Otd. Akad. Nauk SSSR, Ser. Khim. Nauk; No. 3, 3-16(May 1973). (In Russian).

Individual sulfoxides and sulfides of different structures and oil sulfides and sulfoxides are systematically compared as extractants for metals with other neutral extractants. Among the metals discussed are Th, U, Y, Mo, Zr, Te, Eu, Nb, and Ru. Possible application of these new extractants in industry and analytical chemistry are discussed. (92 references) (auth)

24186 EXTRACTION OF TANTALUM AND NIOBIUM WITH PETROLEUM SULFOXIDES. Part I. The Extraction with Dilute Sulfoxides. Nikolaev, A. I.; Babkin, A. G.; Maiorov, V. G.; Chistyakov, B. E. (Inst. of Chemistry and Technology of Rare Elements and Minerals, Apatity, USSR). Izv. Sib. Otd. Akad. Nauk SSSR, Ser, Khim. Nauk; No. 3, 26-31(May 1973). (In Russian).

The effect of aqueous solution composition on the extraction and separation of tantalum and niobium using 30% sulfoxides in kerosene as the extractant was studied. (auth)

24187 EXTRACTION OF TANTALUM AND NIOBIUM WITH PETROLEUM SULFOXIDES. Part II. The Extraction with Undiluted Sulfoxides. Nikolaev, A. I.; Babkin, A. G.; Maiorov, V. G. (Inst. of Chemistry and Technology of Rare Elements and Minerals, Apatity, USSR). Izv. Sib. Otd. Akad. Nauk SSSR, Ser. Khim. Nauk; No. 3, 32-36(May 1973). (In Russian).

The conditions of extraction and separation of tantalum and niobium with undiluted sulfoxides were investigated. An increase in extractant capacity and the improvement of extraction indices in comparison with dilute sulfoxides are reported. (auth)

24188 INVESTIGATION OF NIOBIUM AND TANTALUM EXTRACTION WITH PETROLEUM SULFOXIDES. Golovacheva, T. S.; Startsev, V. N.; Novokshonova, V. D.; Nikitin, Yu. E.; Yankovskaya, N. V. Izv. Sib. Otd. Akad. Nauk SSSR, Ser. Khim. Nauk; No. 3, 36-41(May 1973). In Russian).

The results of research on the extraction of niobium and tantalum from fluoride–sulfate solutions using petroleum sulfoxides are described and compared. Niobium pentoxide and potassium fluorotantalate corresponding to the technical specifications were prepared from industrial solutions. (auth)

24189 STUDIES ON THE EXTRACTION BEHAVIOR OF PETROLEUM SULFOXIDES. Golovacheva, T. S.; Startsev, V. N.; Yudanova, N. V.; Nikitin, Yu. E. Izv. Sib. Otd. Akad. Nauk SSSR, Ser. Khim. Nauk; No. 3, 55-59(May 1973). (In Russian).

The results of research on extraction of zinc, copper, cobalt, and nickel from chloride solutions and that of tellurium from chloride–sulfate solutions using petroleum sulfoxides are given. It was found that sulfoxide can be used for extraction of anionic complexes of nonferrous and rare metals. (auth)

24190 TELLURIUM(IV) EXTRACTION WITH SULFOXIDES FROM HYDROCHLORIC ACID SOLUTIONS. Murinov, Yu. I.; Nikitin, Yu. E.; Rozen, A. M. (Inst. of Chemistry, Ufa, USSR). Izv. Sib. Otd. Akad. Nauk SSSR, Ser. Khim. Nauk; No. 3, 62-63 (May 1973). (In Russian).

Tellurium(IV) extraction using sulfoxides from hydrochloric acid solutions was studied. The solvate number is 2, and a mechanism of extraction is suggested. Concentration extraction constants are estimated to be 0.67 and 1.45 for dihexylsulfoxide and 2-heptylsulfoxidethiophane, respectively. A proposition about coordination of the tellurium atom to the sulfoxide's oxygen based on ir spectra is suggested. (auth)

24191 EXTRACTION OF NITRATE COMPLEXES OF NITROSORUTHENIUM WITH SOME SULFUR-CONTAINING EXTRACTANTS. Sinitsyn, N. M.; Travkin, V. F.; Plotinskii, G. P.; Popov, A. A.; Mikhailov, V. A. (Moscow Inst. of Fine Chemical Tech.). Izv. Sib. Otd. Akad. Nauk SSSR, Ser. Khim. Nauk; No. 3, 64-66(May 1973). (In Russian).

Data on the extraction of nitrate complexes of nitrosoruthenium with di-n-heptylsulfoxide, di-n-octylsulfide, and di-n-heptylsulfone are given. (auth)

24192 PROCESS FOR SEPARATING YTTRIUM VALUES FROM THE LANTHANIDES. Gaudernack, B.; Hannestad, G.; Hundere, I. (to Forskningsgruppe for Sjeldna Jordarter). U U. S. Patent 3,751,553. 7 Aug 1973. Priority date 20 Jul 1971, Norway. 12p.

An improved liquid–liquid extraction process for the separation of yttrium values from the elements of the lanthanide series and other impurities is disclosed. The light lanthanide elements are separated by extraction from an aqueous nitrate solution with an organic solution of a quaternary ammonium nitrate. The heavy lanthanides are subsequently removed from the aqueous solution by extraction with an organic solution of a quaternary ammonium thiocyanate. (auth)

24193 SOLVENT EXTRACTION PROCESS FOR PURIFICATION OF BERYLLIUM. Suziki, H.; Einaga, H.; Mori, Y. (to National Inst. for Researches in Inorganic Materials). U. S. Patent 3,751,557. 7 Aug 1973. Priority date 10 Jul 1970, Japan. 10p.

A solvent extraction process for the purification of beryllium using an aminopolycarboxylic acid as a masking or sequestering agent is reported. An aqueous solution system is prepared containing the beryllium compound to be purified, an aminopolycarboxylic acid, water, and a compound selected from the group consisting of β-ketocarboxylic esters and malonic diesters. The pH of the solution is adjusted to 4.5 to 9. The aqueous solution system is extracted with a water-immiscible, organic solvent, back-extracting the resulting organic solvent phase with an aqueous solution of a mineral acid, and recovering the beryllium compound from the resulting aqueous solution phase. (auth)

24194 EXTRACTION OF NIOBIUM, TANTALUM, AND GOLD WITH OIL SULFOXIDES FROM INDUSTRIAL SOLUTIONS. Chernyak, A. S.; Smirnov, G. I.; Bobrova, A. S.; Mikhailov, V. A.; Torgov, V. G.; Druzhina, G. Ya.; Kostromina, O. N. (Inst. of Inorganic Chemistry, Novosibirsk, USSR). Izv. Sib. Otd. Akad. Nauk SSSR, Ser. Khim. Nauk; No. 3, 42-47(May 1973). (In Russian).

Use of a mixture of C_6-C_8 alcohols as the diluent in the extraction of niobium and tantalum from their solutions in mixtures of HF and H_2SO_4, with oil sulfoxides is discussed. The collective extraction of niobium and tantalum using a 50% mixture of oil sulfoxides and C_6-C_8 alcohols was studied. The extraction of metals from industrial solutions was successfully proved on a pilot-scale unit with mixer-settler extractors. It was found that oil sulfoxides are usable also for the extraction of gold(I) from industrial eluates containing thiourea and sulfuric acid. (auth)

24195 MOLYBDENUM AND TUNGSTEN EXTRACTION WITH OIL SULFOXIDES FROM HYDROCHLORIC ACID SOLUTIONS. Mikhailov, V. A.; Gil'bert, E. N.; Torgov, V. G.; Palant, A. A.; Reznichenko, V. A.; Shapiro, K. Ya.; Rybakov, V. N.; Penchalov, V. A. (Inst. of Inorganic Chemistry, Novosibirsk, USSR). Izv. Sib. Otd. Akad. Nauk SSSR, Ser. Khim. Nauk; No. 3, 48-55(May 1973). (In Russian).

Properties of oil sulfoxides and TBP with respect to Mo and W extraction either from hydrochloric acid solutions or industrial hydrochloric acid decomposition solutions of Scheelite–Powellite are compared. Dependence of Mo distribution coefficients on aqueous phase composition is discussed. (auth)

24196 OPERATION TECHNIQUE OF A PILOT SOLVENT EXTRACTION PLANT FOR THE SEPARATION OF MATERIALS OF NUCLEAR INTEREST. de Amorim, H. A. L.; Blatt, V. (Administracao da Producao da Monazita, Sao Paulo, Brazil). pp 257-266 of III Interamerican Conference on Materials Tech-

nology. Buenos Aires; Centro Regional de Ayuda Tecnica (1972). (In Spanish)

From 3rd Inter-American conference on materials technology; Rio de Janeiro, Brazil (14 Aug 1972). See CONF-720832-.

Parameters were determined for the construction and operation of the pilot plant comprising three stages of mixer–decanters and several circulation systems. Two lines of operation are presented: separation of U and Mo in sulfuric acid medium, and separation of U, Th, and rare earths in nitric and sulfuric acid media. This technique will simplify the processing of monazite. (DLC)

24197 SORPTION OF ELEMENTAL IODINE BY AV-17 ANION EXCHANGE RESIN FROM CHLORIDE SOLUTIONS. Lemeshko, N. V.; Ksenzenko, V. I.; Zakgeim, A. Yu. J. Appl. Chem. USSR (Engl. Transl.); 46: No. 3, 602-607(Mar 1973).

Translated from Zh. Prikl. Khim.; 46: No. 3, 574-579(Mar 1973).

The partition coefficient of iodine is influenced by the chloride ion concentration in solution and by the iodine content in the resin. Iodide ions are formed in the system resin AV-17–NaCl–$CaCl_2$–$MgCl_2$–I_2–H_2O as a result of contact of the solution with the resin. Study of the influence of the ratio of the amounts of iodine in ionic and elemental forms on sorption of iodine under static and dynamic conditions showed that the optimal ratio corresponds to the composition of the complex I_3^-. Sorption of iodine should be conducted in practice at a ratio of ionic to elemental iodine corresponding to the complex I_3^-; this results in a saving of about 30% of the oxidant while the sorption rate is maximal. (auth)

24198 SORPTION OF MOLYBDENUM BY AV-17 ANION EXCHANGE RESIN OF MACROPOROUS STRUCTURE FROM ELECTROCHEMICAL LEACH LIQUORS. Kholmogorov, A. G.; Nadol'skii, A. P.; Il'ichev, S. N.; Kovalev, M. P. J. Appl. Chem. USSR (Engl. Transl.); 46: No. 3, 588-591(Mar 1973).

Translated from Zh. Prikl. Khim.; 46: No. 3, 561-565(Mar 1973).

The macroporous anion exchanger AV-17 × 8P is an effective sorbent for molybdenum in the highly polymerized state. The presence of sodium salts (NaCl, Na_2SO_4) in the molybdate solution narrows the region of molybdenum polymerization. The optimal pH range for extraction of molybdenum from electrochemical leach liquors is pH = 3 to 1. The TDEC of AV-17 × 8P resin is three times that of commercial AN-1 anion-exchange resin. (auth)

24199 DEVELOPMENTS IN ION EXCHANGE. Vernon, F. (Univ. of Salford, Eng.). Selec. Annu. Rev. Anal. Sci.; 2: 83-119 (1972).

A review is presented of progress in those areas of ion exchange that are concerned with exchange on resins. It does not cover inorganic exchangers, liquid ion exchangers or redox exchangers. The subject is dealt with under the following headings: theoretical; chelating and special purpose ion exchangers; ion exchange in mixed solvent systems; analytical separations; water treatment. (UK)

24200 MECHANISM AND KINETICS OF THE EXCHANGE OF LANTHANIDE IONS BETWEEN A CATION EXCHANGER AND AN AQUEOUS SOLUTION OF NITRILOTRIACETIC ACID AND ITS SALTS. Mitrofanova, N. D.; Martynenko, L. I.; Perova, I. N. (Moscow State Univ.). Russ. J. Phys. Chem. (Engl. Transl.); 47: No. 2, 189-191(Feb 1973).

Translated from Zh. Fiz. Khim.; 47: No. 2, 334-336(Feb 1973).

The separation factors α for the lanthanide pairs Nd–Pr, Sm–Nd, and Er–Ho, determined by the eluting of lanthanides with nitrilotriacetic acid solutions, show that in the adsorption zone of the ion-exchange column the separation of the lanthanide mixtures takes place mainly via the mononitrilotriacetates and in the separation zone via the dinitrilotriacetates. The high concentration of the non-complexed lanthanide ions in the adsorption zone leads to a slower rate of attainment of ion-exchange equilibrium than in the separation zone. (auth)

24201 THEORETICAL CALCULATION OF PARTITION COEFFICIENTS IN THE EXTRACTION OF NON-POLAR COMPOUNDS. Kuznetsova, E. M.; Rashidova, D. Sh. (Moscow State Univ.). Russ. J. Phys. Chem. (Engl. Transl.); 47: No. 2, 244-245(Feb 1973).

Translated from Zh. Fiz. Zhim.; 47: No. 2, 436-437(Feb 1973).

A method is proposed for calculating theoretically the partition coefficient in the extraction of non-polar compounds from an aqueous phase by organic solvents, which requires a knowledge of the geometrical dimensions and the polarisabilities of the molecules of the extractable compound. Entirely satisfactory agreement is obtained between calculated and experimental coefficients in the extraction of osmium tetroxide, chlorine, bromine, and iodine. (auth)

24202 SORPTION OF MOLYBDENUM BY ANION-EXCHANGE RESINS. Kats, E. M.; Kolosova, G. M.; Nikashina, V. A. (Inst. of Geochemistry and Analytical Chemistry, Moscow). Russ. J. Phys. Chem. (Engl. Transl.); 47: No. 2, 197-200(Feb 1973).

Translated from Zh. Fiz. Zhim.; 47: No. 2, 349-352(Feb 1973).

The concentration constants for the exchange of molybdate ions for chloride ions on AV-17 and EDE-10P anion exchange resins were obtained. The relationship between the kinetic coefficient and the linear flow rate of the solution for the two resins was also studied. Calculations on sorption dynamics on AV-17 anion exchange resin yielded a satisfactory agreement between the experimental and calculated elution curves. (auth)

24203 DYNAMICS OF ION-EXCHANGE SORPTION IN THE PRESENCE OF COMPLEX-FORMING AGENTS. II. Selective Elution for a Linear Sorption Isotherm. Matorina, N. N.; Buchatskii, P. M.; Chmutov, K. V. (Inst. of Physical Chemistry, Moscow). Russ. J. Phys. Chem. (Engl. Transl.); 47: No. 2, 187-189 (Feb 1973).

Translated from Zh. Fiz. Khim.; 47: No. 2, 329-333(Feb 1973).

The chromatographic separation of micro- and macrocomponents by elution with complex-forming agents which bind the ions separated into non-sorbed complexes was examined. Selective elution of microcomponents is accompanied by the contraction of the initial band if the ions separated have a higher sorption affinity for the resin than the ions saturating the free sorbent bed. Under these conditions, it is possible to achieve chromatographic separation for high saturations of sorption columns. The possibility of calculating the conditions for the selective elution of the microcomponent, the rate of migration of the microcomponent band, and its width during migration in the free resin bed was demonstrated for the separation of microamounts of yttrium and macroamounts of cerium with the aid of diethylenetriaminepentaacetic acid solutions. (auth)

24204 THIN-LAYER CHROMATOGRAPHY OF INORGANIC IONS. V. Chromatography in the System: Silica Gel (Impregnated with Tributyl Phosphate)–Aqueous Solutions of LiCl, NaBr, and NaI. Muchova, A.; Jokl, V. (Univ., Bratislava). Chem. Zvesti; 27: No. 3, 348-354(1973). (In German).

Chromatography of 24 metal ions on silica gel layers, impregnated with tributyl phosphate, was carried out. As mobile phases the aqueous solutions of LiCl, NaBr, and NaI were used. R_F values were summarized as a function of the concentration of mobile phase and on the basis of some examples dependence of R_M values upon the logarithm of mobile phase concentration was demonstrated. Though the results correspond with those obtained under the same conditions on layers impregnated with liquid ion exchangers, it is presupposed that not ion exchange, but extraction mechanism according to the scheme $(M^{m+})_{aq} + (m\ X^-)_{aq} + (n\ TBP)_o \rightleftharpoons (n\ TBP\ MX_m)_o$ is responsible for the chromatographic behaviour of the studied ions. Examples of separation of mixtures containing 3 to 6 metal ions were carried out, including: Mn(II)–Bi(III)–Zn(II)–U(VI)–Fe(III); Co(II)–Cu(II)–Bi(III)–Cd(II)–U(VI)–Fe(III); Cu(II)–Fe(III)–Zn(II)–U(VI)–Bi(III)–Ag(I); Al(III)–Fe(III)–U(VI)–Cd(II)–Sn(II); Co(II)–Cu(II)–Bi(III)–U(VI)–Zn(II); Ba(II)–Mg(II)–Be(II)–U(VI)–Zn(II); Sr(II)–Ca(II)–Tl(I); and Co(II)–Fe(III)–Mn(II)–U(VI)–Zn(II). (auth)

Inorganic, Organic, and Physical Chemistry

Chemical and Physicochemical Properties

Refer also to abstracts 25054, 25055, 26839, 26866, 26877, 26878, 26882, 26891, 26892, 26894–26896, 26905, 26934, 26939, and 26943.

24205 (MLM-1514) HEAT OF FUSION OF PETN. Kantz, M. R.; McGraw, H. R. (Mound Lab., Miamisburg, Ohio). 16 Aug 1968. Contract AT(33-1)-Gen-53. 11p. Dep. NTIS $3.00.

Declassified 31 Oct 1972.

The applicability of the comparative DTA method was demonstrated by measurement of fusion heat of two compounds with known values, azobenzene and benzoic acid. The heat of fusion values of three PETN products were determined by this technique; they fall in the range of 28 to 32 cal/g. (auth)

24206 EQUILIBRIUM DISTRIBUTION OF LITHIUM AND BISMUTH BETWEEN LIQUID LITHIUM–BISMUTH ALLOYS AND MOLTEN LITHIUM CHLORIDE AT 650 TO 680°. Ferris, L. M.; Bredig, M. A.; Smith, F. J. (Oak Ridge National Lab., TN). J. Phys. Chem.; 77: No. 19, 2351-2357(13 Sep 1973).

The distribution of lithium and bismuth between liquid Li–Bi alloys and molten LiCl was measured at several temperatures between 650 and 800°C. The extent of their distribution to the LiCl increased dramatically at each temperature with a moderate increase in the lithium concentration of the alloy; for example, at 650°C, the bismuth concentration in the LiCl increased from

about 5 to 4800 ppM as the lithium concentration in the alloy increased from 10 to 50 at.%. The ratio of "excess" lithium to bismuth in the LiCl generally was about 3, suggesting that salt-like Li_3Bi was selectively dissolved from the alloys. The measured equilibrium bismuth concentrations in the LiCl in the temperature range 650 to 800°C can be expressed as $\ln N_{Bi(d)} = 4 \ln N_{Li(m)} + 2.579 N_{Li(m)} + 2.211 - 9465/T(°K) + 0.0832 \exp[3090/T(°K)]$, with an estimated uncertainty in $\ln N_{Bi(d)}$ of ±0.2. In this expression, N, (d), and (m) denote mole fraction, dissolved in salt phase, and dissolved in alloy phase, respectively. Some data were obtained using molten LiBr as the salt phase at 650°C. Bismuth concentrations (mole fractions) in the LiBr were about twice as high as those obtained with LiCl at the same alloy concentrations. (auth)

24207 APPLICATION OF POURBAIX DIAGRAMS TO SYSTEMS OF FUSED FLUORIDES. Construction Details. Bamberger, C. E. Energ. Nucl. (Madrid); 17: No. 82, 133-142(1973). (In Spanish).

A large part of the actual progress in the science of fused salts is due to the construction and operation of the MSRE and to the studies made on the MSBR, which include studies on the fused fluorides. These studies include the determination of equilibrium constants of heterogeneous reactions, which are of great interest in the graphic representation known as Pourbaix diagrams. In the present study emphasis is placed on the details of their construction and on some advantageous aspects insufficiently considered previously. (tr-auth)

Isotope Effects

24208 KINETIC ISOTOPE EFFECTS IN REACTIONS OF HOT METHYL RADICALS WITH HYDROGEN. Ting, C. T.; Weston, R. E. Jr. (Brookhaven National Lab., Upton, NY). J. Phys. Chem.; 77: No. 19, 2257-2266(13 Sep 1973).

The photolysis at 185 nm of CH_3Br or CD_3Br was used as a source of "hot" methyl radicals which subsequently abstract a hydrogen atom from methyl bromide or from added hydrogen. Relative rate constants for abstraction from H_2 or D_2 were determined by isotopic analysis of the methane produced. The results are discussed in terms of various models for the photodissociation dynamics of alkyl halides. The normal isotope effect for the reaction of hot CH_3 with H_2 or D_2 is predicted by cross sections calculated from activated complex theory, but this theory does not predict the inverse effect observed in the corresponding reactions of hot CD_3. (auth)

24209 STEREOCHEMICAL DEPENDENCE OF THE CHEMICAL-SHIFT ISOTOPE EFFECT. Lambert, J. B.; Greifenstein, L. G. (Northwestern Univ., Evanston, IL). J. Amer. Chem. Soc.; 95: No. 18, 6150-6152(5 Sep 1973).

In order to test some of the theories forwarded to explain polyatomic chemical-shift isotope effects, a series of molecules (cyclohexyl fluorides) containing D-C-C-F fragment with differing known torsional arrangements about the saturated C-C bond were prepared. The vicinal isotope effect has a strong stereochemical dependence that parallels the previously known dependence of the β secondary kinetic deuterium isotope effect. The chemical-shift isotope effect is twice as large when the dihedral angle is 180° as when it is 60°. These observations place certain constraints on the theories developed to explain this phenomenon. (DHM)

24210 ^{14}C ISOTOPE EFFECTS IN THE 1,3-DIPOLAR ADDITION OF N,α-DIPHENYLNITRONE AND STYRENE. A Concerted Cyclic Process. Benjamin, B. M.; Collins, C. J. (Oak Ridge National Lab., TN). J. Amer. Chem. Soc.; 95: No. 18, 6145-6146(5 Sep 1973).

It was found that the primary ^{14}C kinetic isotope effects in the 1,3-dipolar addition of N,α-diphenylnitrone and styrene to yield 2,3,5-triphenylisooxazolidine are consistent with Huisgen's concerted, cyclic mechanism and inconsistent with the diradical mechanism. (DHM)

24211 SOLVENT AND CATION DEPENDENCE OF THE TETRAHYDROBORATE, BH_4^-, RAMAN SPECTRUM. Shirk, A. E.; Shriver, D. F. (Northwestern Univ., Evanston, IL). J. Amer. Chem. Soc.; 95: No. 18, 5901-5904(5 Sep 1973).

Raman spectral data were collected in the B-H stretching region of tetrahydroborate in a variety of solvents: $LiBH_4$ and $NaBH_4$ in pyridine, H_2O ($NaBH_4$ only), isopropyl alcohol, 1,2-dimethoxyethane (glyme), and bis(2-methoxyethyl) ether (diglyme). The $LiBH_4$ spectrum was observed for tetrahydrofuran (THF) and diethyl ether (Et_2O) solutions. Spectra for the $LiBH_4$-Et_2O system, which are unique, indicate strong Li-BH_4 interaction through hydride bridges. The other systems appear to involve weaker cation-anion interaction. For $LiBH_4$ in diglyme the presence of two types of species is demonstrated by the temperature dependence of the Raman spectrum. Data in aqueous solution gave no striking evidence for H···H hydrogen bonding. All of the fundamentals for BH_4^- and BD_4^- in aqueous media are presented, along with the corresponding force constants. (auth)

24212 DIRECT SPECTROSCOPIC EVIDENCE FOR A DEUTERIUM SOLVENT EFFECT ON THE LIFETIME OF SINGLET OXYGEN IN WATER. Kajiwara, T.; Kearns, D. R. (Univ. of California, Riverside). J. Amer. Chem. Soc.; 95: No. 18, 5886-5890(5 Sep 1973).

The $^1\Delta_g$ oxygen dimol emission produced from the decomposition of hydrogen peroxide was studied in H_2O and in D_2O. These studies provide direct spectroscopic proof, that there is a solvent deuterium effect on the lifetime of singlet oxygen and thus confirm earlier results that were based on indirect laser photolysis measurements. The pH dependence of the H_2O_2 decomposition and the chemiluminescence were also studied to provide more information about the nature of the reaction. (auth)

24213 SOLVENT DEUTERIUM ISOTOPE EFFECTS IN ALCOHOLS. Effect of Solvent-base System on Kinetic Solvent Isotope Effects in Hydrogen Abstraction Reactions. Levin, J. O. (Univ. of Umeaa, Sweden). Chem. Scr.; 4: No. 2, 85-88(1973).

Kinetic solvent isotope effects (KSIE's) in the base catalyzed racemization reactions of a number of optically active ketones and nitriles were determined in the solvents MeOH, EtOH, i-PrOH, t-BuOH, and the same O-deuterated alcohols. The KSIE in a reaction is defined as k_{ROH}/k_{ROD}, k_{ROH} and k_{ROD} being the rate constants for the reaction in the two alcohols. According to a model proposed in a previous paper, the KSIE should be less than 1.0 when the reaction is catalyzed by an alkoxide ion, and greater than 1.0 when catalyzed by a nitrogen base. With alkoxide catalysis the KSIE's in the reactions studied were all found to be less than 1.0, ranging from 0.42 to 0.61. The magnitude of the KSIE in the four alcohols was found to vary in the following manner, using the corresponding alkoxide as a base: Me ≃ t-Bu < Et < i-Pr. This order is discussed. The temperature dependence of the KSIE was also studied and found to follow a simple exponential relationship. A number of reactions with triethylamine catalysis were also studied. The KSIE's in these reactions were found to be in the range 0.8 to 1.6. (SW)

24214 KINETIC SOLVENT ISOTOPE EFFECTS FOR SOME ACID CATALYSED REACTIONS. Leveson, L.; Thomas, C. W. (Bath Univ. of Tech., Eng.). Chem. Ind. (London); No. 14, 694 (21 Jul 1973).

Kinetic isotope effects, k_H/k_D, were measured for the following acid catalyzed reactions in 50% and 80% dioxane-water or D_2O containing HCl: hydrolysis of 9-diazofluorene, phenylbenzoyldiazomethane, ω diazoacetophenone, and ethyl diazoacetate, and the rearrangement of 1-phenylbut-2-en-1-ol. Results are shown tabulated. (UK)

24215 DUAL MECHANISM FOR H → D EXCHANGE IN 1,2,4-TRIAZINES. Paudler, W. W.; Lee, J.; Chen, T. K. (Univ. of Ohio, Athens). Tetrahedron; 29: No. 16, 2495-2497(Aug 1973).

H-3 of a series of 1,2,4-triazines is subject to base-catalyzed H → D exchange. This exchange appears to occur via an anionic intermediate. Under neutral conditions, H-3 → D-3 exchange occurs via a covalently hydrated intermediate, in those 1,2,4-triazines where covalent hydration has been shown to take place in acidic media. (auth)

24216 LIQUID AMMONIA SOLUTIONS. X. A Raman Study of Interactions in the Liquid State. Lemley, A. T.; Roberts, J. H.; Plowman, K. R.; Lagowski, J. J. (Univ. of Texas, Austin). J. Phys. Chem.; 77: No. 18, 2185-2191(30 Aug 1973).

The results of a Raman study of liquid NH_3, ND_3, and ND_2H and of NaI and $NaClO_4$ solutions in liquid NH_3 are reported. The resolution of the experimental envelopes in the N-H and N-D stretching regions suggests a two-species model for the solvent structure. Band positions for the pure liquids and solutions at different temperatures are discussed in terms of the proposed liquid structure model. (auth)

24217 **FORCE FIELD AND TUNNELING EFFECTS IN THE H-H-Cl REACTION SYSTEM. DETERMINATION FROM KINETIC-ISOTOPE-EFFECT MEASUREMENTS.** **Stern, M. J.; Persky, A.; Klein, F. S. (Isotope Department, Weizmann Institute of Science, Rehovot, Israel). J. Chem. Phys. 58: No. 12, 5697-5706 (15 June 1973).**

An iterative method is used to obtain, within the framework of the transition-state theory, sets of force constants from experimental kinetic-isotope-effect data for the reaction system. $H_2+Cl-[H-H-Cl]^{\ddagger}-H+HCl$. Two sets of force constants, describing quite different transition-state structures, are found to be equally compatible with all available rate data for the reactions of chlorine atoms with H_2, HD, HT, DT, D_2, and T_2. These force fields are compared with force fields derived by semiempirical methods.

Measurements of the intramolecular kinetic isotope effect, i.e., the relative rate of production of HCl/DCl in the reaction HD+Cl, are shown to be especially suited for selecting compatible transition-state models. (auth)

24218 EFFECTS OF VARIATIONS IN REACTION COORDINATE EIGENVALUE AND EIGENVECTOR ON THE RATE AND HYDROGEN ISOTOPE EFFECTS OF THE REACTION $H + Cl_2 \rightarrow HCl + Cl$. Wei, G.; Yankwich, P. E. (Department of Chemistry, University of Illinois, Urbana, Illinois 61801). J. Chem. Phys. 58: No. 12, 5552-5560 (15 June 1973).

Effects on the rate constant k, and on)he temperature independent and temperature dependent factors of k_H/k_D, of variations in the eigenvalue (λ_1) and eigenvector (L_1) associated with the reaction coordinate have been studied by computation for the reaction $H+Cl_2$–$HCl+Cl$. A slightly bent transition state was assumed and its diagonal force field maintained invariant at partial bond levels. The properties of the transition state were varied by systematic manipulation of the three off-diagonal force constants. Values of the several temperature dependent quantities calculated were controlled largely by the interaction force constant between the H . . . Cl stretch and the H . . . Cl . . . Cl bend. Curving the potential barrier affects drastically the range of reaction coordinate "compositions" which correspond to acceptable transition states, but neither k nor k_H/k_D is sufficiently sensitive to barrier curvature to allow an estimate of a "best value" for λ_1 by comparison of calculated and experimental values. Eigenvector variations have similarly modest effects on k, but the sensitivity of k_H/k_D seems enough greater that it could be used for model refinement if experimental results of moderate precision were available. Both these sensitivities would be enhanced if the transition state diagonal force field were treated as a parameter in concert with L_1. The hypothesized general inverse correlation between isotope effects and reaction rates is shown to be limited by temperature. (auth)

24219 DEUTERIUM ISOTOPE EFFECTS ON THE ^{13}C CHEMICAL SHIFTS AND CARBON COUPLING CONSTANTS IN DEUTERATED COMPOUNDS. Breitmaier, E. (Univ., Tuebingen, Ger.); Jung, G.; Voelter, W.; Pohl, L. Tetrahedron; 29: No. 16, 2485-2489(Aug 1973). (In German).

The isotope effects on the ^{13}C NMR chemical shifts and coupling constants ($^{13}C-^{1}H$ and $^{13}C-^{2}H$) were determined by pulse Fourier transform ^{13}C NMR investigation at 22.63 MHz for more than 30 common deuterated and protonated solvents. The observed isotope effects correlate with hybridization and electron withdrawal at the coupling carbon within the series of comparable compounds. In agreement with MO-theoretical calculations a linear correlation between the J_{CD} values of CD_X groups and the J_{CH} values of the corresponding CH_X groups was found. The experimentally determined J_{CD} values show an average deviation from the calculated line $J_{CD} = (\gamma_D/\gamma_H)J_{CH} = 0.154 \times J_{CH}$ on the order of ±1 Hz. (auth)

24220 ENTHALPIES OF DILUTION OF TETRA-N-ALKYL AMMONIUM BROMIDES IN WATER AND HEAVY WATER. Levine, A. S.; Wood, R. H. (Univ. of Delaware, Newark). J. Phys. Chem.; 77: No. 20, 2390-2396(27 Sep 1973).

The enthalpies of dilution of R_4NBr (where R = methyl, ethyl, n-propyl, and n-butyl) were measured at 25° from 3 m' (aquamolality) to about 0.08 m' in D_2O and from 3 m' to about 0.008 m' in H_2O. The results for H_2O were extrapolated to infinite dilution using an extended Debye-Hückel equation. The difference between H_2O and D_2O was fit to a polynomial in m'. The results for low concentrations in H_2O indicate that cation-cation interactions have a large positive effect on the excess enthalpy while cation-anion interactions have a large negative effect on the excess enthalpy. An equation is derived which shows that at low enough concentrations these effects can be separated by the concentration dependance of the ion atmospheres of the single ions and the pairs. The difference between the excess enthalpy in H_2O and D_2O shows that structural effects present in H_2O are magnified in D_2O. The difference between H_2O and D_2O solutions for the alkali halides and tetraalkylammonium bromides have the same shape as that predicted by Ramanathan and Friedman's model calculation for a change in cation–anion cosphere overlap. This is surprising for the tetrabutylammonium and tetrapropylammonium bromides where cation-cation overlap is expected to be important. A saturation effect can explain the results. (auth)

24221 HYDROLYSIS OF 3-METHOXYPHTHALIDES IN AQUEOUS ACID. Effect of Substituents in the 3 Position. Weeks, D. P.; Crane, J. P. (Seton Hall Univ., South Orange, NJ). J. Org. Chem.; 38: No. 19, 3375-3379(21 Sep 1973).

The hydrolysis of a series of 3-methoxy 3-substituted phthalides in aqueous sulfuric acid was studied. At ~1 M acid concentration the substituents establish a relative rate order of $H > CH_3 > C_6H_5 > C_2H_5 > \alpha$-naphthyl > i-$C_3H_7$. 3-Methoxypthalide itself exhibits behavior consistent with a unimolecular hydrolysis mechanism when various empirical criteria such as the Zucker-Hammett hypothesis, entropy of activation, and deuterium oxide solvent isotope effect are applied. The behavior of the other compounds tends to depart from that expected from a unimolecular mechanism but can be reconciled with a unimolecular process in terms of a restriction of rotation as the molecule approaches the transition state leading to a cationic intermediate. (auth)

24222 SUBSTITUENT EFFECTS ON THE HYDROLYSIS OF 3-METHOXY-3- PHENYLPHTHALIDES. Weeks, D. P.; Cella, J.; Chen, L. T. (Seton Hall Univ., South Orange, NJ). J. Org. Chem.; 38: No. 19, 3383-3386(21 Sep 1973).

The effect of substituents on the para position of the 3-phenyl ring on the rate of acid-catalyzed hydrolysis of 3-methoxy-3-phenylphthalides was determined. The rates correlate with σ^+ and the reaction constant, ρ, is –1.2. The rate-enhancing effect of a methoxy group on the 6 position of the phthalide ring is more pronounced than that of a methoxy group on the para position of the 3-phenyl ring. All the compounds studied give Zucker-Hammett slopes of 0.68 ± 0.02 and rather highly negative entropies of activation and several of the compounds show deuterium oxide solvent isotope effects of ~0.5. These data are consistent with an A1 hydrolysis mechanism in which hindered rotation in the transition state is a complicating factor. 3-Methoxy-3-phenyl-6-nitrophthalide suffers hydrolysis more rapidly than one would expect. (auth)

24223 ROLE OF HYDRATE FORMATION IN THE CHROMIUM(VI) OXIDATION OF ALDEHYDES. Rocek, J.; Ng, C. S. (Univ. of Illinois, Chicago). J. Org. Chem.; 38: No. 19, 3348-3350(21 Sep 1973).

Reaction rates for the chromic acid oxidation of a series of aliphatic aldehydes were determined and correlated with aldehyde hydration equilibria. A value of $\rho^* = -1.1$ for the oxidation of aldehyde hydrates was obtained. The results support a mechanism consisting of a rate-limiting oxidative decomposition of a chromic acid ester of an aldehyde hydrate. The applicability of the mechanism to the oxidation of aromatic aldehydes is discussed. The deuterium isotope effect for the oxidation of privaldehyde ($k_H/k_D = 7.9$) shows that even this aldehyde reacts "normally" by carbon-hydrogen rather than by a carbon-carbon cleavage. (auth)

24224 STERIC EFFECTS IN BICYCLIC SYSTEMS. IV. Base-Catalyzed Enolization of Bicyclo[2.2.2]Octan-2-one, Bicyclo[2.2.1] Heptan-2-one, and Bicyclo[2.1.1]Hexan-2-one. Abad, G. A.; Jindal, S. P.; Tidwell, T. T. (Univ. of Toronto, West Hill, Ont.). J. Amer. Chem. Soc.; 95: No. 19, 6326-6331(19 Sep 1973).

Deuterium exchange of bicyclic ketones in 2:1 (v/v) dioxane–D_2O catalyzed by NaOD was measured by a mass spectrometric technique developed for this purpose. Second-order rate constants (M^{-1} sec^{-1}) at 25.0° and activation parameters ΔH^* (kcal mol^{-1}) and ΔS^* (eu) were determined as follows: bicyclo[2.2.2]octan-2-one (1) 3.03×10^{-2}, 13.1, and –21; bicyclo[2.2.1]heptan-2-one (2) 5.58×10^{-2}, 14.0, and –17(exo); 8.26×10^{-5}, 17.1, and –20(endo); and bicyclo[2.1.1]hexan-2-one (3) 6.04×10^{-6}, 17.8 and –23. The rate of base-catalyzed bromination of cyclohexanone was found to exceed that of 1 by a factor of 3.1 in water at 10.0°. The secondary isotope effect k_D/k_H for deuteration of 1 was 0.94 ± 0.04 at 25.0°. These results are interpreted as showing that the rates reflect the relative facility of proton abstraction from the different sites, and that the principal factors governing the rates of attack are the angle strain generated in the resulting enolates, which favors reactivity in the series 1 > 2 > 3, and the greater steric blocking of access of the base to the reaction site by a two-carbon bridge as opposed to a one-carbon bridge, which favors reactivity in the series exo-2 > endo-2, and 3 > 1. (auth)

24225 STRUCTURE AND DECOMPOSITION OF THE C_7H_8.+ ION FORMED BY γ-HYDROGEN REARRANGEMENT. Levsen, K.; McLafferty, F. W.; Jerina, D. M. (Cornell Univ., Ithaca, NY). J. Amer. Chem. Soc.; 95: No. 19, 6332-6335(19 Sep 1973).

The abundant C_7H_8. + ions (2) found in the mass spectra of $C_6H_5CH_2CH_2YH$ (1) compounds were studied by examination of the behavior of deuterium-labeled ions of different internal energies. The positional identity of the hydrogen atoms in 2 ions undergoing metastable decomposition is completely lost; the isotope effect is identical with that found for the metastable decomposition of toluene (3) and cycloheptatriene (5) ions, consistent with isomerization of 2, 3, and 5 to a common structure before decomposition. That structure appears to resemble 5 more closely than 2 or 3. However, 2 ions of higher internal energies undergo direct cleavage loss of hydrogen before isomerization more readily than do 3 and, especially, 5 ions; the labeling results are only consistent with rearrangement of the γ-H to yield the methylenecyclohexadiene structure, 1 → 2. (auth)

24226 ENTROPIC CONTROL OF THE PHOTOCHEMICAL REACTIVITY OF ALKYL PHENYL KETONES. Lewis, F. D.;

Johnson, R. W.; Kory, D. R. (Northwestern Univ., Evanston, IL). J. Amer. Chem. Soc.; 95: No. 19, 6470-6472(19 Sep 1973).

In order to provide more detailed information about the transition state for intramolecular γ-hydrogen abstraction, the photochemical behavior of a series of alkyl phenyl ketones having similar n, π* triplet energies, and γ-C–H bond strengths, but differing in conformational mobility was studied. The excited-state reactivity toward γ-hydrogen abstraction was found to be dependent upon molecular conformation and this dependence reflects entropic contributions to the transition state. Deuterium isotope effects on γ-hydrogen abstraction for endo-2-benzoylnorbornane was found to be 4.0 ± 0.2. (DHM)

24227 ISOTOPE CHEMISTRY AND MOLECULAR STRUCTURE. A Simplified Theory of End Atom Isotope Effects. Bigeleisen, J. (Univ. of Rochester, NY); Ishida, T. Contract AT(11-1)-3127. J. Amer. Chem. Soc.; 95: No. 19, 6155-6157 (19 Sep 1973).

A simple theory for the calculation of isotope effects, applicable to end atom substitution, is developed from the finite orthogonal polynomial method of Bigeleisen and Ishida. It is shown that it is possible to calculate the absolute reduced partition function ratio, at room temperature and above, for end substituted isotopic molecules with reasonable accuracy simply from atomic masses and stretching and bending force constants. The method, which is a simple first order calculation, yields directly the relative importance of bending and stretching forces to the isotope effect as a function of the temperature. It does not require solution of the secular equations for the molecular vibrations. It is particularly suited for the study of end atom isotope effects in homologous compounds. The method is illustrated by the comparison of the new simplified method with exact calculations of the deuterium isotope effects in methane, ethane, and benzene and ^{18}O substitution in formaldehyde. (auth)

24228 MICROWAVE SPECTRUM, STRUCTURE AND DIPOLE MOMENT OF TRIMETHYLAMINE–BORANE. Durig, J. R.; Li, Y. S.; Odom, J. D. (Univ. of South Carolina, Columbia). J. Mol. Struct.; 16: No. 3, 443-450(Jun 1973).

The ground state rotational spectra of ten isotopic species of trimethylamine–borane, $(CH_3)_3N^{10}BH_3$, $(CH_3)_3N^{11}BH_3$, $(CH_3)_3N^{10}BD_3$, $(CH_3)_3N^{11}BD_3$, $(CH_3)_3N^{11}BD_2H$, $(CD_3)_3N^{10}BH_3$, $(CD_3)_3N^{11}BH_3$, $(CD_3)_3N^{10}BD_3$, $(CD_3)_3N^{11}BD_3$ and $(^{13}CH_3)(^{12}CH_3)_2N^{11}BH_3$, were measured and the effective moments of inertia obtained. The utilization of Kraitchman's equations leads to an r_s value of the B–H distance of 1.211 ± 0.003 Å and a NBH angle of 105.32 ± 0.16°. By a least squares fit of the rotational constants the following structural parameters were obtained: r(NC) = 1.495 Å, r(BN) = 1.609 Å, and ∠BNC = 110.9°. The value of the dipole moment was found to be 4.59 ± 0.13 D. A lower limit to the barrier to internal rotation of the BH_3 group was determined to be 3.4 kcal/mole. (auth)

24229 ISOTOPE EFFECT IN THE VAPOR PRESSURE FROM THE STANDPOINT OF THE THEORY OF SIGNIFICANT STRUCTURES. Devyatykh, G. G.; Mikheev, V. S.; Stepanov, V. M. (Inst. of Chemistry, Gorky, USSR).. Russ. J. Phys. Chem. (Engl. Transl.); 47: No. 2, 210-212(Feb 1973).

Translated from Zh. Fiz. Zhim.; 47: No. 2, 373-376(Feb 1973).

A method is proposed for the calculation of the isotope effect in the vapor pressure over a liquid in terms of the theory of significant structures. In contrast to the procedures employed previously, the method proposed does not require the knowledge of the coordination number, the constant characterising the probability of a transition of the molecule to neighbouring vacancy, or the difference between the ratios of the molar volumes of the isotopic compounds in the solid and liquid states. The isotope effects in the vapor pressure were calculated for CH_4-CD_4; $^{14}N_2-^{15}N_2$; SiH_4-SiD_4; and NH_3-ND_3. (auth)

Isotope Exchange and Isotope Separation

Refer also to abstracts 24293, 24303, 24322, and 24363.

24230 (COO-1222-60) FUNDAMENTAL STUDIES OF SEPARATION PROCESSES. Technical Progress Report. Rogers, L. B. (Purdue Univ., Lafayette, Ind. Dept. of Chemistry). Jul 1973. Contract AT(11-1)-1222. 16p. Dep. NTIS $3.00.

Research progress is reported in four areas, namely, isotopic separations, high pressure chromatography, chromatographic data processing, and high-precision gas chromatography. In isotopic separations, the final difficult stage of uniformly coating long capillary columns with an active solid has been started. The goal is to allow the gas chromatographic determination of $^{13}CO_2$ in a mixture with $^{12}CO_2$ without the use of a mass spectrometer. In a related study, the gas-chromatographic determination of the relative vapor pressures of the ^{16}O and ^{18}O species of methanol has been shown to yield results in good agreement with those obtained by classical methods. Measurements on the corresponding ^{12}C and ^{13}C species are now in progress. (auth)

24231 HOMOGENEOUS ISOTOPE EXCHANGE BETWEEN THALLIUM(I) AND THALLIUM(III) 2-THENOYLTRIFLUORACETONATES IN ORGANIC SOLVENTS. Siroky, L.; Stary, J. (Technical Univ., Prague). Radiochem. Radioanal. Lett.; 14: No. 5-6, 305-308(5 Sep 1973).

The kinetics of the isotope exchange reaction between $^{204}Tl(I)$ and thallium(III)–2-thenoyltrifluoracetonates in benzene and toluene was studied in order to determine the rate constants. It was found that the type of chelating agent used has a great influence on the kinetics. (auth)

24232 ROLE OF THE LIQUID PHASE IN GAS–LIQUID–SOLID CHROMATOGRAPHY AND ITS INFLUENCE ON COLUMN PERFORMANCE: AN EXPERIMENTAL APPROACH. Bruner, F.; Ciccioli, P.; Crescentini, G.; Pistolesi, M. T. (Citta Univ., Rome). Anal. Chem.; 45: No. 11, 1851-1859(Sep 1973).

The changes occurring in heats of adsorption, separation factors, HETP vs. u curves and retention characteristics when different amounts of liquid phase are added to graphitized carbon black Sterling FT were studied. Squalane and glycerol were used as extreme cases of liquid phases, and particular separation problems have been taken as examples. Changes in chromatographic features are related to the changes in surface characteristics. Examples of analytical applications are given. The effect of the addition of modifiers on the separation of deuterated and hydrogenated forms of hydrocarbons was also studied. (auth)

24233 EFFECT OF ADDED ELECTRON ACCEPTOR ON THE METHYLENE–AZOMETHINE REARRANGEMENT, A TRAPPED TRANSAMINATION. Guthrie, R. D.; Burdon, L. G.; Lovell, F. L. Jr. (Univ. of Kentucky, Lexington). J. Org. Chem.; 38: No. 18, 3114-3119(7 Sep 1973).

It was shown that the carbanion intermediate in the hydrogen–deuterium exchange of N-neopentylidenebenzylamine, IV, can be intercepted by nitrobenzene and in the presence of oxygen converted to benzoic acid, pivalic acid, benzamide, and pivalamide. A detailed kinetic analysis of exchange, isomerization, and trapping processes was carried out. Evidence that this reaction occurs for other azaallylic anions is also presented. (auth)

24234 KINETICS OF TRITIUM ISOTOPE EXCHANGE BETWEEN PYRIDINIUM PERCHLORATE AND HYDROGEN CHLORIDE. Szydlowski, J.; Sobkowski, J. (Univ., Warsaw). Rocz. Chem.; 47: No. 5, 1031-1038(1973).

The kinetics of isotope exchange reaction of tritium between gaseous hydrogen chloride and pyridinium perchlorate were studied over the temperature range of 70 to 245°C. The mechanism of this reaction is proposed. (auth)

24235 HYDROGEN–TRITIUM EXCHANGE BETWEEN MOLECULAR TRITIUM AND AROMATIC HYDROCARBONS IN SOLUTION. Pri-Bar, I. (Israel Atomic Energy Commission, Beersheba); Buchman, O.; Avramoff, M. Inorg. Nucl. Chem. Lett.; 9: No. 8, 831-834(Aug 1973).

It is stated that in the well known Wilzbach reaction the need for long exposure times, dictated by the low exchange rate of H-atoms attached to C, leads to low yields and products containing many radioactive impurities. An investigation is described on the labeling of aromatic hydrocarbons in solution using T gas. Of the various solvents used only acetic acid and dimethyl sulfoxide led to the incorporation of mullicurie amounts of T into the dissolved hydrocarbon. The hydrocarbons used were naphthalene, fluorene, and authracene and the solvents ethanol, acetic acid, and DMSO. Data are tabulated for H–T exchange in the dissolved hydrocarbons and for T incorporation in the solvent. The high degree of tritiation of naphthalene in acetic acid is explained by the protogenic nature of the solvent, but the high labeling of DMSO dissolved naphthalene is in contrast with the low yield of T incorporated in this solvent under the reaction conditions used (170 mm Hg pressure and 25°C). The labeling of the hydrocarbons studied decreased with increasing stability of their charge-transfer complex with DMSO, the highest results being obtained with naphthalene, and these complexes may be considered as intermediates in the exchange reaction. It was also found that Pt(II) complexes, such as K_2PtCl_4, catalyse the exchange of aromatic hydrocarbons with molecular T in non-aqueous DMSO. Contrary to the results obtained for labeling in the absence of a catalyst a reaction of first order with respect to T and zero order with respect to naphthalene was found when using a Pt complex, and the rate determining step, in this case, appears to be the formation of an inter-

mediate tritide complex. The catalytic exchange reaction has the convenience or tritiation using T gas at high activities, low pressure, and room temperature. It has been used to obtain tritiated naphthalene with specific activity of 300 m Ci/mmol and low radioactive impurities content. (auth)

24236 PREPARATION OF RADIOACTIVE MONO- AND DI-IODOSULFOBROMOPHTHALEIN. Kato, S.; Kurata, K. (to Dainabot Radioisotope Labs. Ltd.). U. S. Patent 3,743,713. 3 Jul 1973. Filed date 22 Jun 1971. 4p.

A method of preparing radioactive mono- and di-iodosulfobromophthalein for clinical purposes is described by which the ratio of di- to monoiodosulfobromophthalein can be controlled. No separation and purification of the compounds is required for their use in clinical diagnostic procedures. The compounds, particularly the monoiodo compound, offer a number of advantages in comparison to sulfobromophthalein when used for biological investigation. (auth)

24237 APPLICATION OF LASERS TO ISOTOPE SEPARATION. Moore, C. B. (Univ. of California, Berkeley). Accounts Chem. Res.; 6: No. 9, 323-328(Sep 1973).

The advantages and feasibility of large-scale applications of separated stable isotopes are discussed. Several methods for the separation of isotopes using lasers are reviewed; possible advantages and disadvantages are given. (JGB)

24238 HYDROGEN–DEUTERIUM EXCHANGE KINETICS OF THE C-2 PROTONS OF IMIDAZOLE AND HISTIDINE COMPOUNDS. Bradbury, J. H.; Chapman, B. E.; Pellegrino, F. A. (Australian National Univ., Canberra). J. Amer. Chem. Soc.; 95: No. 18, 6139-6140(5 Sep 1973).

The kinetics of the deuteration of various substituted imidazole and histidine compounds that serve as suitable model compounds for the exchange behavior in proteins is reported. (DHM)

24239 POSSIBILITY OF HETEROGENEOUS EXCHANGE OF ^{18}O IN THE MgO–O SYSTEM AT LOW TEMPERATURE AS A RESULT OF THE PRELIMINARY IRRADIATION OF MgO. Antoshin, G. V.; Tkachenko, O. P.; Shpiro, E. S.; Minachev, Kh. M. (Inst. of Organic Chemistry, Moscow). Kinet. Katal.; 14: No. 3, 810 (1973). (In Russian).

Heterogeneous exchange at −78°C was detected between O_2 and oxygen chemisorbed on γ-irradiated MgO. Possible explanations of this observation were advanced. (JSR)

24240 KINETICS OF ISOTOPIC EXCHANGE OF THE REACTION COMPONENTS IN THE SYNTHESIS OF AMMONIA. Napol'skikh, G. A.; Kasatkina, L. A. (Moscow Chemical-Technological Inst.). Kinet. Katal.; 14: No. 3, 653-660(1973). (In Russian).

The kinetics of the isotopic exchange in molecular nitrogen(I), between gaseous and adsorbed nitrogen(II), between ammonia and hydrogen(III), between ammonia and nitrogen(IV), and ammonia decomposition reactions(V) on iron were investigated using the K-4 catalyst for ammonia synthesis. It was found that the reactions I, II, IV, and V proceed under comparable conditions with a first order rate and low value of the activation energy, whereas the rate of reaction III is several orders higher and the activation energy is much lower. On the basis of a comparison of the rates of these reactions it was concluded that the formation–rupture of the N–N bonds cannot be limited by the step of the decomposition–synthesis of ammonia. The reactions I, II, IV, and V can have general limiting steps. This step can be adsorption–desorption of the nitrogen, rupture (weakening) of the bonds between atoms of nitrogen, or migration of the adsorbed nitrogen atoms on the surface of the catalyst. (tr-auth)

24241 EFFECT OF THE METHOD OF PREPARATION AND PRELIMINARY PROCESSING ON THE OXYGEN ISOTOPIC EXCHANGE OF CHROMIUM OXIDE. Eval'd, G.; Muzykantov, V. S.; Boreskov, G. K. (Inst. of Catalysis, Novosibirsk, USSR). Kinet. Katal.; 14: No. 3, 627-632(1973). (In Russian).

The isotopic exchange of the oxygen of chromium oxide, prepared from different materials and under different conditions, was investigated. It was established that the reaction capacity of the oxygen on the Cr_2O_3 surface drops during increase of the concentration of the surface chromate group which is determined by the impurity of the alkali metal and the annealing temperature. (tr-auth)

24242 ULTRAFILTRATION BY A COMPACTED CLAY MEMBRANE. 1. Oxygen and Hydrogen Isotopic Fractionation. Coplen, T. B.; Hanshaw, B. B. (Univ. of Chicago). Geochim. Cosmochim. Acta; 37: No. 10, 2295-2310(Oct 1973).

Laboratory experiments were carried out to determine the magnitude of the isotopic fractionation of distilled water and of 0.01 N NaCl forced to flow at ambient temperature under a hydraulic pressure drop of 100 bars across a montmorillonite disc compacted to a porosity of 35% by a pressure of 330 bars. The ultrafiltrates in both experiments were depleted in D by 2.5‰ and in ^{18}O by 0.8‰ relative to the residual solution. No additional isotopic fractionation due to a salt filtering mechanism was observed at NaCl concentrations up to 0.01 N. Adsorption is most likely the principal mechanism which produces isotopic fractionation, but molecular diffusion may play a minor role. The results suggest that oxygen and hydrogen isotopic fractionation of ground water during passage through compacted clayey sediments should be a common occurrence, in accord with published interpretations of isotopic data from the Illinois and Alberta basins. (auth)

24243 EFFECT OF PPh_3-LIGANDS ON THE ISOTOPIC EXCHANGE OF THE HYDROGEN OF π-AROMATIC LIGANDS IN ARENE–CHROMIUM DICARBONYL–TRIPHENYLPHOSPHINE. Kursanov, D. N.; Setkina, V. N.; Baranetskaya, N. K.; Zdanovich, V. I.; Yurtanov, A. I.; Apisimov, K. N. (Inst. of Elemental Organic Compounds, Moscow). Izv. Akad. Nauk SSSR, Ser. Khim.; No. 6, 1359-1362(Jun 1973). (In Russian).

By substitution of the CO ligand in $ArCr(CO)_3$ complexes for PPh_3 ligands the rate of the isotopic exchange reaction of hydrogen with CF_3COOD increases by more than three orders. In hydrogen isotopic exchange reactions with C_2H_5ONa into C_2H_5OD PPh_3 ligands retard the hydrogen exchange into π-benzene ring in $C_6H_6Cr(CO)_2PPh_3$ approximately 20 times in comparison with $C_6H_6Cr(CO)_3$. (tr-auth)

24244 HYDROGEN EXCHANGE OF TRIPHENYLPHOSPHONIUMCYCLOPENTADIENYLIDEMOLYBDENUM TRICARBONYL. Zdanovich, V. I.; Yurtanov, A. I.; Zhakaeva, A. Zh.; Setkina, V. N.; Kursanov, D. N. (Inst. of Elemental-Organic Compounds, Moscow). Izv. Akad. Nauk SSSR, Ser. Khim.; No. 6, 1375-1376(Jun 1973). (In Russian).

Triphenylphosphoniumcyclopentadienylidemolybdenum tricarbonyl enters into hydrogen exchange reactions with deuteroethanol in neutral medium with the same rate as that of noncomplexed triphenylphosphoniumcyclopentadiene. (tr-auth)

24245 INFLUENCE OF THE ELECTROLYTE ADSORPTION ON THE Na SELF-DIFFUSION IN PERMUTIT G. Levi, H. W.; Miekeley, N. (Hahn-Meitner-Institut fuer Kernforschung, Berlin). Radiochim. Acta; 18: No. 3, 138-140(1972). (In German).

Sodium self-diffusion in Permutit G was measured by isotopic exchange with NaCl solutions of various concentrations. The apparent self-diffusion coefficients were found to be dependent on the concentration of the exchange solution. This is true even in a concentration range where no interference by film kinetics is to be expected. This phenomenon is being explained in terms of electrolyte adsorption by the exchanger. This is in accordance also with the concentration dependence of activation enthalpies that were observed as well. These findings are of some significance for the selection of proper conditions in the determination of self-diffusion coefficients in ion exchangers. (auth)

24246 ISOTOPE SEPARATION ON LIQUID CATION EXCHANGERS BY A METHOD BASED ON MATHEMATICAL EXPERIMENTAL DESIGN. Tikhomirov, I. A.; Larionov, V. V.; Vergun, A. P.; Avdeev, L. A. (Tomsk Polytechnic Inst., USSR). Russ. J. Phys. Chem. (Engl. Transl.); 47: No. 2, 193-194(Feb 1973).

Translated from Zh. Fiz. Zhim.; 47: No. 2, 341-343(Feb 1973).

Isotope separation on a bis(2-ethylhexyl)phosphoric acid (D2EHPA) liquid cation exchanger involving four variable factors can be described, in terms of a rotatabular uniform composition design, by an equation of an ellipsoid, the surface of which corresponds to equal values of the enrichment coefficient. (auth)

24247 PREPARATION OF CINNAMIC ACIDS LABELLED WITH DEUTERIUM OR TRITIUM AT THE α-POSITION. Manitto, P. (Univ., Milan); Monti, D.; Gramatica, P.; Sabbioni, E. J. J. Chem. Soc., D; No. 16, 563-564(22 Aug 1973).

(E)-[α-^{2}H]- and (E)-[α-^{3}H] cinnamic acids can be easily obtained from the corresponding α-trimethylammonio-acids (or their ester halides) via Hofman elimination in deuteriated and tritiated water respectively. (auth)

Feed Materials Processing

Refer also to abstracts 24460, 24461, and 24475.

24248 (CNEA-MP-4/81) HYDROMETALLURGICAL RECOVERY OF URANIUM, NICKEL, AND ARSENIC FROM A MINERAL. Soler, C. T.; Garcia Bourg, J. M.; Lopez Pardo, J. E. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina)). 1972. 11p. (In Spanish). INIS.

A hydrometallurgical solution is suggested for the beneficiation

of a concentrate by flotation of the San Santiago mineral (La Rioja, Argentina). This concentrate contains 0.94% of U; 2.36% of Ni; and 3.61% of As. The proposed scheme of treatment is the following: (1) sulfuric acid lixiviation; (2) selective extraction of the uranium by amine solvents, and recovery of the uranium by precipitation; (3) separation of the arsenic by precipitation as ferric arsenate at regulated pH; and (4) recovery of the nickel in the form of concentrates obtained by precipitation at regulated pH and eventual redissolution with sulfuric acid to obtain nickel sulfate. (tr-auth)

24249 (NIM-1509) INSTRUMENTATION DEVELOPED FOR ELECTROCHEMICAL STUDIES OF THE LEACHING OF URANIUM DIOXIDE. Lowe, K. (National Inst. for Metallurgy, Johannesburg (South Africa)). 5 Jun 1973. 22p. Dep. NTIS (U. S. Sales Only) $3.25.

Electrodes, prepared from UO_2, with resistances varying from 20 to 4000 ohms were used in electrochemical studies, and a potentiostat capable of compensating for the total ohmic cell resistance, including the electrode and solution resistance, had to be built. This unwanted resistance had to be measured accurately so that the correct value of compensation could be applied to the potentiostat, and an ideal method, which makes use of a constant-current circuit and an interrupter, was developed. This new method can be applied universally and has no obvious disadvantages. A novel sweep generator, which is especially useful for slow-sweep voltammetric studies, was designed for use in conjunction with the new method. (auth)

24250 URANIUM RECOVERY. George, D. R.; Ross, J. R. (to Secretary of the Interior). U. S. Patent 3,743,695. 3 Jul 1973. Filed date 17 Sep 1970. 4p.

An improved method is described for recovery of uranium by elution from an ion exchange resin using sulfuric acid as the eluting agent. The elution is conducted in a series of stages, each dilution stage being coupled with a solvent extraction stage, thereby achieving a substantially improved rate of uranium elution. (auth)

24251 APPARATUS FOR OBTAINING WATER-FREE URANIUM COMPOUNDS. Pirk, H.; Ploger, F.; Vietzke, H. U. S. Patent 3,740,863. 26 Jun 1973. Filed date 9 May 1969. 4p.

An apparatus for the recovery of powdered water-free uranium compounds from suspensions is described. The apparatus includes a filter, preferably a rotating horizontal suction filter connected to a fluidized bed. (auth)

24252 EXTRACTION OF URANIUM FROM ELLIOT LAKE ORE BY VAPOUR-PHASE CHLORINATION. Lapage, R.; Marriage, J. W. (Atomic Weapons Research Establishment, Aldermaston, Eng.). Inst. Mining Met., Trans., Sect. C; 82: C101-C102(Jun 1973).

As the demand for uranium increases, new or improved extraction processes will be required if the price of uranium is to be maintained as lower grade ores come to be worked. Vapor-phase chlorination has been suggested and examined in the past, but has not been exploited commercially. A preliminary examination indicated that, for Elliot Lake ore, processing costs would be comparable with current sulfuric acid leaching if 95% of the uranium were extracted from −12 mesh ore at 1000°C with a chlorine usage of 340 lb/ton ore, a 95% chlorine recycle and 67% heat recycle. Any improvement in these factors could give a substantial saving and might warrant further work on heat recycle from the spent ore, construction materials and design of large-scale high-temperature plant. The experiments described were of a preliminary nature to decide whether further expenditure was worthwhile. (auth)

Radiation Chemistry

Refer also to abstracts 24239, 24328, 24673, 24676, 24678, 24720, 25250, 25252, 25318, and 26885.

24253 (BARC/I-164) HYDRATED ELECTRON IN CHEMISTRY. Ghosh Mazumdar, A. S. (Bhabha Atomic Research Centre, Bombay (India)). 1972. 21p. INIS.

Solvated electron i.e., the electron which is formed in the solvent water commonly known as hydrated electron (e^-_{aq}), is dealt with in this paper. Formation of hydrated electron by reducing agents, and by the effect of radiation is discussed. Identification of hydrated electron by the method of competition kinetics, absorption spectrophotometry, and other methods of identification is given. Structure and properties of hydrated electrons are also briefly mentioned. (INIS)

24254 (CEA-CONF-2328) PRODUCTION OF RADIOVULCANIZED NATURAL LATEX. Laizier, J. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). 7 Mar 1973. 11p. (In French). (CONF-730343-1). Dep. NTIS (U. S. Sales Only) $3.00.

From Meeting on the development of industrial applications of radiation chemistry; Paris, France (13 Mar 1973).

The prevulcanization of rubber latex can be carried out by irradiation with electron beams or γ rays. The product Precurtex is obtained relatively inexpensively and is easy to work with. It is stable with respect to time and possesses a remarkable purity. The mechanisms involved in the cross-linking are as yet unknown. (Fr)

24255 (EUR-4954, pp 67-72) UTILIZATION OF THE PROPOSED PULSED GAMMA AND NEUTRON FACILITY IN RADIATION AND RADIO-CHEMISTRY. Shiokawa, T. (Tohoku Univ., Sendai). Apr 1973.

From joint meeting on pulsed neutrons and their utilization; Ispra, Italy (17 Sep 1971).

Some promising utilizations of the proposed facility are discussed in relation to radiation chemistry, nuclear chemistry and radioactivation analysis. (EU)

24256 (NYO-3949-1) FINAL REPORT ON STUDIES OF RADIATION EFFECTS ON POLYMERS AND POLYMERIZATION. Szwarc, M. (State Univ. of New York, Syracuse (USA). Dept. of Chemistry). 8 Feb 1973. Contract AT(11-1)3710. 66p. Dep. NTIS $5.45.

Research progress on the following problems is reported: (1) Synthesis of a new class of polymers and copolymers involving units of hexamethylphosphoric triamide in their backbone (poly-HMPA). These polymers are expected to form interesting membranes if successfully crosslinked by γ-irradiation. (2) Studies of the properties of this class of polymers, their crosslinking by γ-irradiation, and development of some film membranes. (3) Study of modification of polymer films by attaching to their surfaces carboxylic groups. The process involves irradiation of chosen polymer films in CO_2 atmosphere by γ-rays. To follow the reaction, a radioactive CO_2 labeled by ^{14}C was used. The process makes the hydrophobic surfaces hydrophilic. (4) Unsuccessful studies of adhesion of polymer films to metal surfaces under the influence of electric field. (5) Unsuccessful attempt to stabilize the electrons ejected by γ-rays in order to initiate anionic polymerization. (auth)

24257 (RRL-3238-452) STEADY STATE AND TIME RESOLVED ESR STUDIES OF RADIOLYTICALLY PRODUCED RADICALS. Fessenden, R. W. (Mellon Inst. of Science, Pittsburgh, PA. Radiation Research Labs.). 5 Sep 1973. Contract AT(11-1)-3238. 35p. (CONF-730921-2). Dep. NTIS $3.75.

From 5th L. H. Gray Memorial conference on fast processes in radiation chemistry and biology; Brighton, UK (10 Sep 1973).

Research progress is reported on the application of electron spin resonance (ESR) to the detection of radicals produced by in situ radiolysis of aqueous solutions. Experiments are described in which a time resolution of 1 microsecond has been provided for use with pulse radiolysis. The conditions of these experiments closely match those used with more conventional optical absorption techniques. The sensitivity of time-solved ESR experiments is discussed and shown to approach that of steady-state operation at comparable average radical production rates. Factors affecting the detectability of various radicals such as the ESR line width are also discussed as are the complications arising from spin-selective reactions. Results of several pulse experiments are given to illustrate the potential of the method. Applications to the second-order reaction of $\dot{C}H(CO_2^-)_2$ and the reactions of OH with ascorbic acid are discussed. (auth)

24258 (UCLA-12-919, pp 11-12) RADIATION CHEMISTRY OF LIPIDS. 1973.

In annual progress report for the period ending June 30, 1973.

Research progress is reported in the following areas: formation of stearaldehyde from stearic acid; effect of chain-length on decarboxylation in γ radiolysis of normal saturated fatty acids; and non-gaseous γ radiolysis products of stearic acid. (DHM)

24259 (UCLA-12-919, pp 116-117) RADIATION CHEMISTRY OF NUCLEIC ACID CONSTITUENTS. 1973.

In annual progress report for the period ending June 30, 1973.

24260 (UCLA-12-919, pp 120-122) RADIATION BIOCHEMISTRY OF PROTEINS AND AMINO ACIDS. 1973.

In annual progress report for the period ending June 30, 1973.

Research progress is reported in the following areas: interactions contributing to the tyrosyl circular dichroism bands ribonucleas S and A; effects of hydrogen bonding and solvents upon the tryptophanyl absorption band, (studies using 2,3-dimethylindole); circular dichroism of modified tryptophan residues, 3-oxindolyl-L-alanine; and radiation effect on lysozyme. (DHM)

24261 DECAY OF HO_2 AND O_2^- RADICALS CATALYZED BY SUPEROXIDE DISMUTASE. A Pulse Radiolytic Investigation.

Rabani, J. (Hebrew Univ., Jerusalem); Klug, D.; Fridovich, I. Israel J. Chem.; 10: No. 6, 1095-1106(1972).

The pulse radiolysis technique was used in the investigation of the dismutation of superoxide radicals, O_2^- and HO_2, in the presence of superoxide dismutase in aqueous solutions. The decay of superoxide radicals in the presence of the enzyme was found to be first order in both enzyme and superoxide concentrations. An apparent second order reaction rate constant was found to be about 2×10^9 M^{-1} sec^{-1}, decreasing slightly as the pH is increased from 5 to 9.5. A mechanism which accounts for all our observations is proposed. It includes two steps: (1) formation of a product (EO_2^- or E^-) from one enzyme (E) molecule and one O_2^- radical ion; (2) regeneration of E by a reaction of this product with an additional O_2^- ion radical. The reaction rate constant $k_{(E+O_2^-)} = (1.4 \pm 0.2) \times 10^9$ and $k_{(E^- \text{ (or } EO_2^-)+O_2^-)} = (1.9 \pm 0.6) \times 10^9$ M^{-1} sec^{-1} were measured at pH = 7 in an oxygenated 0.16 M sodium formate solution. (auth)

24262 RADIOLYTIC DECOMPOSITION OF PERFLUOROMETHYLCYCLOHEXANE. II. Dependence on Dose, Dose Rate, Temperature, Type of Radiation, and Oxygen Content. Gehringer, P. (Oesterreichische Studiengesellschaft fuer Atomenergie GmbH, Seibersdorf); Proksch, E.; Krenmayr, P. Atomkernenergie; 21: No. 3, 215-221(1973). (In German).

The radiolysis of perfluoromethylcyclohexane was measured over a wide range of experimental conditions. The total decomposition under gamma irradiation amounts to about 3.1 molecules/100 eV and shows little or no dependence on dose, dose rate, and oxygen content of the sample. It increases slightly with increasing temperature and decreases to about half its value when changing to fast neutron irradiation. This behavior and the virtual absence of oxygen containing radiolysis products leads to the proposal that the radiolysis mechanism is mainly ionic. With respect to the use of the title compound as a neutron-insensitive dosimeter, measurement of total decomposition or of perfluorocyclohexane production are being proposed. (GE)

24263 HIGH TEMPERATURE THERMOLUMINESCENCE IN POLYETHYLENE. Blake, A. E.; Charlesby, A.; Randle, K. J. (Royal Military Coll. of Science, Shrivenham, Eng.). J. Polym. Sci.; Polym. Lett. Ed.; 11: No. 3, 165-168(Mar 1973).

The observation of thermoluminescence in polyethylene between room temperature and the crystalline melting point is reported. The glow curve produced by irradiation at room temperature (21°C) under a nitrogen atmosphere shows the luminescence in three distinct regions with peaks at 51°C, 72°C, and a broad emission which drops rapidly as the melting point is approached. A glow curve produced by γ irradiation at −196°C is too weak for the components to be identified but shows a large decrease in total glow. It is apparent that a reduction in irradiation temperature of 21°C attenuated the 72°C peak. The effect of treatment with hexane or anthracene on the thermoluminescence irradiated at 0°C was also studied. (DHM)

24264 GAS-PHASE REACTION OF TERT-BUTYL IONS WITH ARENES. Remarkable Selectivity of a Gaseous, Charged Electrophile. Cacace, F.; Giacomello, P. (Univ., Rome). J. Amer. Chem. Soc.; 95: No. 18, 5851-5856(5 Sep 1973).

tert-Butyl ions from the γ radiolysis of neopentane were allowed to react in the gas phase with benzene, toluene, and their mixtures, contained at low concentrations in the gas. The reaction was studied at neopentane pressures ranging from 8.7 to 720 Torr, in the presence of a thermal radical scavenger (O_2). The effects of a gaseous base (EtOH) and of an inert gas (Ar) on the reaction were also investigated. The tert-butyl ions react with toluene in the gas phase, yielding p- and m-tert-butyltoluenes, whose ratio markedly increases with the pressure of neopentane and the concentration of the base. At the higher neopentane and base pressures, the isomeric composition of the products appears to be kinetically controlled and corresponds to a para:½ meta ratio in excess of 35. This value is fully comparable to the highest ratios measured in the study of the liquid-phase tert-butylation and reflects the remarkable positional selectivity of the gaseous, unsolvated tert-butyl cation. Furthermore, the gaseous reagent displays a significant substrate selectivity, as indicated by a k_T/k_B ratio in excess of 55 measured in the competition experiments. The mechanism of the gas-phase alkylation is discussed and compared with those of different gaseous electrophiles, characterized by a considerably lower selectivity. It is concluded that a low positional and substrate selectivity does not necessarily represent a typical mechanistic feature of the gas-phase aromatic substitutions by charged reagents and that the low selectivity observed in previous studies is likely to arise from the extreme electrophilic character of the reagents so far investigated. (auth)

24265 EFFECT OF PRESSURE ON THE RATES OF REACTION OF SOLVATED ELECTRONS AND HYDROGEN ATOMS IN LIQUID METHANOL. Jha, K. N.; Freeman, G. R. (Univ. of Alberta, Edmonton). J. Amer. Chem. Soc.; 95: No. 18, 5891-5896(5 Sep 1973).

The yield of hydrogen at 296°K from neutral methanol and 0.5 mM perchloric acid in methanol was $g(H_2) = 5.45$, independent of pressure in the range 1 bar to 5.4 kbar. In 0.10 M perchloric acid in methanol, $g(H_2) = 6.25$ at 1 bar and 6.00 at 5.4 kbar were measured. The efficiencies of scavenging free ion solvated electrons by nitrobenzene in neutral and acidic methanol, and by acetone in neutral methanol, decreased greatly with increase in pressure. The corresponding efficiencies of scavenging in the spurs were little affected by pressure. The following rate constant ratios at 1 bar and differences of volumes of activation were measured: $e^-_{solv} \rightarrow CH_3O^-_{solv} + H(9)$, $e^-_{solv} + S \rightarrow S^-_{solv}(12)$, $e^-_{solv} + H^+_{solv} \rightarrow H(5)$; $k_{12}/k_9 = 4.3 \times 10^4$ M^{-1} for nitrobenzene and 1.7×10^4 M^{-1} for acetone, $\Delta V^{\ddagger}_{12} - \Delta V^{\ddagger}_{9} = 15$ cm^3/mol for both solutes; $k_5/k_{12} = 3.9$ when S is nitrobenzene, $\Delta V^{\ddagger}_{5} - \Delta V^{\ddagger}_{12} = -3$ cm^3/mol, adjusted to zero ionic strength. The free ion yield in methanol is $g(e^-_{solv})_{fi} = 1.8 \pm 0.1$ at 1 bar and 1.9 at 5.4 kbar. The density-normalized range of the secondary electrons in methanol at 296°K is $bd = 1.4 \times 10^{-7}$ g/cm^2, independent of pressure. Competition between the reactions $H + CH_3OH \rightarrow H_2 + CH_2OH(10)$ and $H + S \rightarrow HS(21)$ was studied at 296°K at 1 bar and 5.4 kbar. Values of k_{21}/k_{10} at 1 bar and $(\Delta V^{\ddagger}_{21} - \Delta V^{\ddagger}_{10})$ averaged between 1 bar and 5.4 kbar for two solutes S are: cyclohexene, 430, +2.0 cm^3/mol; phenol, 130, −2.0 cm^3/mol. The volume of activation of hydrogen atom addition to the aromatic ring is 4 cm^3/mol more negative than that of addition to a monoolefin. Rate constants of reaction of solvated electrons with several solutes at 295°K, measured by the pulse-radiolysis-spectroscopy technique, are M^{-1} sec^{-1}: cyclohexene, $<1 \times 10^4$; hexene-1, 1×10^5; benzene, 1×10^6; phenol, 7×10^6. The phenol reaction with e^-_{solv} produces hydrogen, perhaps via $C_6H_5OH^-_{solv} \rightarrow H + C_6H_5O^-_{solv}$ (4). The hydrogen yields from pure acetone were $g(H_2) = 0.90$ at 1 bar and 0.55 at 5.4 kbar, while that from pure cyclohexene $g(H_2) = 1.2$ independent of pressure. (auth)

24266 BIMOLECULAR DISAPPEARANCE OF PYRIDINYL RADICALS IN WATER. Kosower, E. M. (Tel Aviv Univ., Israel); Teuerstein, A.; Swallow, A. J. J. Amer. Chem. Soc.; 95: No. 18, 6127-6128(5 Sep 1973).

The 1-methyl-4-carbamidopyridinyl radical disappears in water at a rate that is proportional to the square of the radical concentration and has the unusual feature of being strongly pH dependent. The radical was generated through one-equivalent reduction of the corresponding pyridinium ion in aqueous buffers containing the appropriate combinations of sodium formate and formic acid, phosphate, or sulfuric acid, using 2 to 5 μsec pulses of 10 MeV electrons. The radical was found to disappear by second-order kinetics with rate constants k at pH 6.9 and 4.0 of 2.5×10^4 and 6.8×10^8 M^{-1} sec^{-1}, respectively. (DHM)

24267 IONIZATION CONSTANTS AND SPECTRAL CHARACTERISTICS OF SOME SEMIQUINONE RADICALS IN AQUEOUS SOLUTION. Rao, P. S.; Hayon, E. (Army Natick Labs., MA). J. Phys. Chem.; 77: No. 19, 2274-2276(13 Sep 1973).

The ionization constants, absorption maxima, and extinction coefficients of the semiquinone radicals and radical anions of 12 quinones were determined. These were obtained in aqueous solutions in the presence of 1 to 3 M tert-butyl alcohol or isopropyl alcohol by electron e^-_{aq} attachment, using the technique of pulse radiolysis. Various benzoquinones, naphthaquinones, anthraquinones, diphenoquinone, epinephrine, and adrenalone were studied. The ionization constants range from 3.2 to 5.4 These values are correlated with the redox potentials of the corresponding quinones. The decay kinetics of some semiquinone radicals and radical anions were determined. (auth)

24268 CONFIGURATION COORDINATE MODEL FOR THE HYDRATED ELECTRON. II. Jahn–Teller Splitting of the Excited State. Tachiya, M.; Tabata, Y.; Oshima, K. (Tokyo Univ.). J. Phys. Chem.; 77: No. 19, 2286-2290(13 Sep 1973).

The configuration coordinate model for the solvated electron is further developed. The configuration coordinate diagram for the hydrated electron is constructed by calculating the total energies of the hydrated electron under various orientational polarizations which are not necessarily spherically symmetric. Medium relaxation following an optical transition is discussed in terms of this diagram. The Jahn–Teller splitting of the excited state is predicted to be about 0.3 eV. (auth)

24269 EFFECT OF IRRADIATION ON ELECTRODE PROCESSES. The Hydrogen Peroxide Electrode. Airey, P. L. (Australian Atomic Energy Commission, Sutherland). Aust. J. Chem.; 26: No. 7, 1443-1452(Jul 1973).

A study was made of the effect of ^{60}Co γ and 1 MeV electron beam irradiation on hydrogen peroxide electrode in acid solutions. The small positive potential shifts that are observed are due to the effect of the irradiation on the electrode reactions defining the hydrogen peroxide mixed potential. It is deduced from steady

state polarization studies that the HO_2 radical generated radiolytically in the bulk solution is not electrochemically significant. On prolonged irradiation the electrode potential falls to a value negative to $E(H_2O_2)$ if the concentration of radiolytic H_2 builds up sufficiently to establish the H_2-H^+ exchange as an electrochemically significant process. (auth)

24270 POLARIZED ABSORPTION NAPHTHALENE CRYSTALS EXPOSED TO RADIATION. Cadoux, A.; Martin-Bouyer, M. (Centre Universitaire de Chambery, France). J. Chim. Phys.; 70: No 4, 679-683(Apr 1973). (In French).

Orientated single crystals of naphthalene which were irradiated with γ radiation present absorption bands in the 3400 to 5600A region for polarized light. These bands exhibit a partially resolved fine structure at 4.2°K which is attributed to new chemical species at least two of which are radicals. The polarization of the spectra observed for each neutral line of the single crystal confirms the hypotheses of an orientated radical gas. Certain parts of the spectra reveal phonon interaction. The vibrational analyses currently being conducted confirm already existing results from emission experiments and enable the positions of the 0-0 electron transition bands for the two chemical species to be determined. (Fr)

24271 PARAMAGNETIC SPECIES IN IRRADIATED ETHANE-1,2 DIPHOSPHONIC ACID. Whelan, D. J. (Australian Defence Scientific Service, Ascot Vale). Aust. J. Chem.; 26: No. 6, 1357-1361(Jun 1973).

γ-Irradiation of powdered and single crystals of ethane-1,2-diphosphonic acid at room temperature yields three stable free radicals, one in which the unpaired electron is centered on carbon and two in which it is centered on phosphorus. One of the phosphorus-centered free radicals is a sigma radical with ESR parameters g = 1.999, A_{iso} = 81.4 mT, and 2B = 13.1 mT and is assigned the structure $(HO)_2P(O)CH_2CH_2P\cdot(OH)_3$. (auth)

24272 SOME PARAMETERS OF RADIATION POLYMERIZATION OF VINYL MONOMERS IN WOOD PULP. Glukhov, V. I.; Shiryaeva, G. V. Plast. Massy; No. 6, 35-36(1973). (In Russian).

Results are reported for an investigation of heat evolution during radiation polymerization of vinyl monomers in wood pulp under the influence of ^{60}Co γ radiation. It was established that maximal temperature of the reaction mixture rises with increasing value of the γ radiation dose. A proportional relationship is observed between t_{max} and the quantity of the monomer added to the wood pulp; the temperature in the wood pulp is always lower than during the polymerization process of methyl methacrylate in the "mass". The degree of the filling of radiation-chemical apparatus has a definite effect on the warming up of the reaction mixture. (JPRS)

24273 EFFECT OF TRIALLYL ESTERS OF CYANURIC OR ISOCYANURIC ACIDS ON THE RADIATION CROSSLINKING OF POLY(VINYL CHLORIDE). Dakin, V. I.; Egorova, Z. S.; Karpov, V. L. Plast. Massy.; No. 6, 37-38(1973). (In Russian).

It was found that the effectiveness of the crosslinking of poly(vinyl chloride) compositions containing the triallyl ester of cyanuric or isocyanuric acids is identical. Therefore the radicals forming during the isomerization process of triallyl ester of cyanuric acid into the isocyanuric acid are of no consequence as far as the spacial structure of the composition is concerned. These data support the hypothesis of the reaction mechanism based on the formation of free radicals due to the splitting of low molecular weight fragments from the allyl group and from the macromolecules of the polymer itself. (JPRS)

24274 H-ADDUCT RADICALS IN X-IRRADIATED FROZEN SOLUTIONS OF URACIL DERIVATIVES. Van de Vorst, A. (Univ., Liege). Int. J. Radiat. Biol.; 24: No. 1, 81-85(Jul 1973).

An ESR study was made of alkaline frozen solutions of uracil, 2-thiouracil, deoxyuridine, and deoxyuridine-5'-monophosphate disodium $2\frac{1}{2}H_2O$. X-irradiation was carried out at 77°K for 1 hr, corresponding to an approximate dose of 2.5×10^5 rads. The compounds were dissolved in 8N NaOH solution at a concentration of 10^{-1}M. Four kinds of free radicals were observed, two being identified as due to an H-abstraction at the N, and at the C_5 or C_6 positions. The mechanism of formation of these last two was not known. It is suggested that as with the other pyrimidines, the formation of H-adduct radicals in the uracil derivatives require a transitional aniomic stage. (UK)

24275 RADICAL YIELD IN X-IRRADIATED BIOLOGICAL MOLECULES. 1. Glycine. Crippa, P. R.; Porati, A.; Tedeschi, R. A.; Vecli, A. (Univ., Parma, Italy). Int. J. Radiat. Biol.; 24: No. 1, 87-91(Jul 1973).

A study was made of the temperature dependence of the radicals exhibited after x-irradiation of glycine. ESR absorption patterns are presented of x-irradiated polycrystalline glycine (a) irradiated and observed at room temperature and (b) irradiated at room temperature and observed at -163°C. A graph is presented of temperature dependence of 1/A, where A is the ESR absorption pattern area, over a range of 100 to 300°K. It is suggested that within 4%, the experimental data fit a calculated temperature dependence curve. It is pointed out that the presence of a linear term suggests the presence of a Curie-Weiss-like component, but that more sophisticated models could not be excluded. (UK)

24276 GAMMA IRRADIATION OF URACIL IN AERATED AQUEOUS SOLUTIONS. Ducolomb, R.; Cadet, J.; Teoule, R. (CEN, Grenoble, France). Bull. Soc. Chim. Fr.; No. 3, 1167-1174(Mar 1973). (In French).

The radiolysis of uracil by gamma rays (40 Krads) in aerated aqueous solution, at pH 6 and a concentration of 10^{-3} M, was studied (G = -2.49). The following compounds were identified and their concentrations determined: trans(G = 0.62) and cis(G = 0.42) 5,6-dihydroxy-5,6-dihydrouracil, N-formyl N'-glyoxyl urea (probably cyclized into 1-formyl 5-hydroxy hydantoin) (G = 0.72), isodialuric acid (G = 0.10), alloxan (G = 0.06), 5-hydroxy hydantoin (G = 0.18), parabanic acid, oxaluric acid (G approximately equal 0.13), formyl urea (G = 0.27), and urea (G = 0.02). The synthesis and spectral properties (IR, mass spectrometry, NMR) of all these compounds are described. A kinetic study under a flux of 8100 rads/mn followed by irradiation of the derivative compounds enabled the experimental degradation scheme to be established. The compound 5-hydroperoxy-6-hydroxy-5,6-dihydrouracil, which may be a potentially important intermediate, was synthesized with a good yield. (FR)

24277 ELECTRON AND ITS CHEMICAL PROPERTIES. Janovsky, I.; Teply, J. (Inst. of Nuclear Research, Rez, Czech.). Chem. Listy; 67: No. 7, 673-698(Jul 1973). (In Czech).

The reactivity of electron towards different acceptors in different media and mechanisms of reactions are discussed. Various methods of preparation of electron are described. (auth)

24278 DETERMINATION OF RATE CONSTANTS FOR THE REACTION OF H, OH, AND e^-_{aq} WITH SULPHANILIC ACID IN AQUEOUS SOLUTIONS. Murthy, R. N.; Rao, K. N. (Bhabha Atomic Research Centre, Bombay). Radiat. Eff.; 18: No. 1-2, 35-38(Mar 1973).

In the radiolysis of aqueous solutions of sulphanilic acid, the absolute rate constants of its reaction with H and OH were determined by competition kinetics using isopropanol as the competitor. The hydrated electron reaction rate constant with sulphanilic acid was determined at pH 11 using the decay of hydrated electrons produced by the photolytic reaction of OH^- in a H_2^--saturated solution. (auth)

24279 GAMMA RADIOLYSIS OF ETHYL MERCAPTAN IN THE GAS PHASE. Migdal, E.; Forys, M. (Univ., Warsaw). Radiat. Eff.; 18: No. 1-2, 17-20(Mar 1973).

The gamma radiolysis of pure ethyl mercaptan in the gas phase was studied. The pressure and dose dependence of product yields was obtained. Possible mechanism of products formation were considered. (auth)

24280 EARLY EFFECTS OF RADIATION. Radical Pairs in a Single Crystal of Barbituric Acid. Meloe, T. B.; Bergene, R.; Henriksen, T. (Univ. of Oslo). Mol. Phys.; 25: No. 6, 1377-1383 (Jun 1973).

Radical pairs are formed and trapped when barbituric acid is irradiated with electrons at 77°K. The radical pairs were identified and the molecular structure determined in single crystal studies. The two unpaired species, constituting the pair, were found to be identical and equal to the isolated radical previously studied. The radical is formed by a hydrogen abstraction from C_5, and the pair is formed by two such abstractions in neighbor molecules. The pair formation is quite selective and involves exclusively the nearest neighbor molecules. (auth)

24281 RADIATION-CHEMICAL CONVERSION IN FLUORINE-CONTAINING ELASTOMERS UNDER DIFFERENT CONDITIONS OF γ IRRADIATION. Kryukova, A. B.; Kuz'minskii, A. S.; Glinskaya, N. S.; Galil-Ogly, F. A.; Sankina, G. A. Vysokomol. Soedin., Ser. B; 15: No. 5, 367-369(May 1973). (In Russian).

The rates of the radiation-chemical crosslinking and destruction of the fluorine-containing elastomer based on copolymers of vinylidene fluoride with trifluorochloroethylene (copolymer 1), with hexafluoropropylene (copolymer 2), and with perfluoroalkylvinyl diethyl ether (copolymer 3), as well as their radiation vulcanization in a stress state at high temperature were determined both with the type of polymer and with the conditions of irradiation. The rate of crosslinking of copolymers 2 and 3 was higher than copolymer 1; the oxygen of air inhibits crosslinking during γ irradiation; during irradiation in the presence of the oxygen of air the sol fraction is

8 to 10 times higher than in isolation from it; optimal is the vulcanized rubber of copolymer 3, obtained by irradiation in the absence of air. (tr-auth)

24282 PREPARATION, POLYMERIZATION, AND COPOLYMERIZATION OF N-VINYLPHTHALIMIDINE. Murata, K. (Government Industrial Research Inst., Osaka). Bull. Chem. Soc. Jap.; 46: No. 6, 1752-1755(Jun 1973).

The preparation, polymerization, and copolymerization of N-vinylphthalimidine were investigated. The monomer was prepared by the dehydrochlorination of N-(β-chloroethyl)phthalimidine. Polymerization was carried out in the presence of radical or cationic initiators in bulk and in solution. It was found that polymerizability with cationic initiators was larger than that with radical ones. The resulting polymers had a softening point in the range of 160 to 180°C, the reduced viscosities being small. Copolymerization with acrylonitrile and styrene was carried out in dimethylformamide and benzene by radical initiators. The monomer reactivity ratios and Alfrey-Price Q and e values calculated from the copolymerization data of the monomer (M_1) and styrene (M_2) were $r_1 = 0.05$, $r_2 = 7.4$, $Q_1 = 0.30$, and $e_1 = -1.80$. Values for N-vinylpyrrolidone (M_1) were likewise determined for the sake of comparison, and found to be $r_1 = 0.02$, $r_2 = 12.0$, $Q_1 = 0.22$, and $e_1 = -1.99$. (auth)

24283 PHOTORECOMBINATION OF PEROXIDE RADICALS IN POLYTETRAFLUOROETHYLENE. Klinshpont, E. R.; Milinchuk, V. K. (Scientific-Research Physical Chemical Inst., Moscow). Vysokomol. Soedin., Ser. B; 15: No. 5, 332-336(May 1973). (In Russian).

In polytetrafluorethylene in the presence of oxygen, radioinduced peroxide radicals recombine under the influence of uv light. The rate of the reaction depends on the structure of the peroxide radicals and the intensity of the light. In the process of photorecombination, products with yield of 50 to 90 fluorine ions are precipitated on one disappearing peroxide radical. The mechanism of the recombination of the peroxide radical represents a chain process, consisting of an alternation of the reaction of dissociation of the peroxide radical and addition of the oxygen to the radical. (tr-auth)

24284 FREE RADICAL FORMATION IN HYDROCARBON CRYSTALS BY γ IRRADIATION. Anisotropic Hyperfine Couplings in $\dot{C}H_3CH(CH_2)_{33}CH_3$ and Relative Radical Yields in Single Crystal Hexatriacontane. Lund, A.; Kevan, L. (Wayne State Univ., Detroit). J. Phys. Chem.; 77: No. 18, 2180-2183(30 Aug 1973).

The EPR spectra of a single crystal of $C_{36}H_{74}$, hexatriacontane, were analyzed. The radicals $CH_3\dot{C}H(CH_2)_{33}CH_3$ and $R'CH_2\dot{C}HCH_2R''$ are formed after γ irradiation at 195°K in a ratio of approximately 3 to 1. A computer-assisted method was applied to separate the overlapping radical signals. The isotropic and anisotropic coupling constants of $CH_3\dot{C}H(CH_2)_{33}CH_3$ were obtained from a complete single crystal analysis. The parameters are found to agree reasonably well with values derived from the anisotropic couplings of methyl and ethyl radicals and indicate that the radical site is planar. (auth)

24285 RADIATION CHEMISTRY OF POLYETHYLENE. XII. Alkyl Radical Decay and Amorphous Content. Johnson, D. R.; Wen, W. Y.; Dole, M. (Baylor Univ., Waco, TX). J. Phys. Chem.; 77: No. 18, 2174-2179(30 Aug 1973).

The decay of the alkyl free radical, $-CH_2\dot{C}HCH_2-$ in γ-irradiated polyethylene was studied at room temperature and above. No second-order decay component in the total decay process could be observed; instead the decay data were quantitatively interpreted in terms of a fast and slow first-order decay process. It is shown that the slow first-order decay constants increase linearly with the square of the amorphous volume fraction; the fast first-order constants also increase with increase of amorphous fraction, but the data scatter considerably. Hydrogen gas which is soluble only in the amorphous fraction has a marked catalytic effect on both the slow and fast decay processes. The activation energies of both processes are practically identical, so that the large difference in the rates results from differences in the preexponential factor of the Arrhenius equation. (auth)

24286 PRODUCTION OF TRAPPED ELECTRONS IN GLASSY 3-METHYLPENTANE BY PHOTOIONIZATION OF SODIUM. Srinivasan, S. C.; Willard, J. E. (Univ. of Wisconsin, Madison). Contract AT(11-1)-1715. J. Phys. Chem.; 77: No. 18, 2171-2173(30 Aug 1973).

Photoionization of sodium metal dispersed in 3-methylpentane by deposition at 77°K from vapor mixtures yields trapped electrons with ESR line width and half-life similar to electrons produced by γ irradiation of 3MP glass at 77°K. An apparatus for transferring samples condensed on a cold finger at 77°K to an ESR sample tube at 77°K under vacuum is described. A narrow singlet signal at g near 2.0000, observed earlier during illumination of 3MP–metal matrices, and ascribed to weakly trapped electrons, is now known to be an electron cyclotron resonance signal from electrons ejected into the evacuated tube. (auth)

24287 ELECTRON–ELECTRON DOUBLE RESONANCE STUDY OF TRAPPED ELECTRONS IN γ-IRRADIATED 2-METHYLTETRAHYDROFURAN GLASS: MAGNETIC ENERGY TRANSFER BETWEEN TWO DIFFERENT SPIN SYSTEMS. Yoshida, H.; Feng, D.; Kevan, L. (Department of Chemistry, Wayne State University, Detroit, Michigan 48202). J. Chem Phys. 58: No. 11, 4924-4929 (1 June 1973).

Electron–electron double resonance (ELDOR) of trapped electrons and radicals in γ-irradiated 2-methyltetrahydrofuran (MTHF) glass at 77°K was investigated. Magnetic energy pumped into the radical spin system is transferred to the trapped electron spin system to partially saturate it. The cross saturation mechanism is consistent with dipolar cross relaxation in which a radical spin flips down and an electron spin flips up. Analysis of the rate of spin relaxation shows that the reciprocal ELDOR reduction is linear with pumping microwave power with an intercept which gives the ratio of the cross–relaxation time to the electron spin–lattice relaxation time. The experimental data are found to fit this relationship. This ratio of relaxation times is of the order of 0.5 while the relaxation times themselves are in the 10^{-4}–sec range. The observation of cross relaxation in this system supports the concept that the trapped electron and radical are spatially correlated in γ-irradiated MTHF. (auth)

24288 PULSE RADIOLYSIS STUDIES. XXI. OPTICAL ABSORPTION SPECTRUM OF THE SOLVATED ELECTRON IN ETHERS AND IN BINARY SOLUTIONS OF THESE ETHERS. Jou, F. Y.; Dorfman, L. M. (Department of Chemistry, The Ohio State University, Columbus, Ohio 43210). J. Chem. Phys. 58: No. 11, 4715-4723 (1 June 1973).

The optical absorption spectrum of the solvated electron has been determined by pulse radiolysis in the pure liquid ethers: tetrahydrofuran, methyltetrahydrofuran, diethyl ether, dimethoxyethane, diglyme, triglyme, and tetraglyme. The absorption maxima are at 4720, 4650, 4350, 4880, 5220, 5440, and 5580 cm^{-1}, respectively. The half-widths of the bands have also been measured. The oscillator strength, determined for the first four ethers is approximately unity. The absorption bands have been determined in binary solutions with ethylenediamine and for tetrahydrofuran–water over the entire concentraion range. Calculations using a recent form of a cavity–continuum model have been compared with the experimental results. The model shows agreement with the experimental values for the transition energy for an effective cavity radius of about 4 Å and a coordination number of 6 or 8. Kinetics for the attachment of solvated electrons to pyrene and for the reaction of the solvated electron with the solvent counterion have been investigated in several ethers and absolute rate constants determined. (auth)

24289 IDENTIFICATION OF N_3 OR N_3^{2-} RADICALS IN IR-RADIATED AZIDES BY ELECTRON SPIN RESONANCE SPECTROSCOPY AND AB INITIO CALCULATIONS. Claxton, T. A.; Overill, R. E.; Symons, M. C. R. (Leicester Univ., Eng.). Mol. Phys.; 26: No. 1, 75-80(Jul 1973).

On the basis of an INDO calculation, a radical containing three nitrogen atoms formed in irradiated barium azide has recently been identified as $N_3^{\cdot}$, rather than N_3^{2-} as originally proposed. It is suggested that it is unsafe to argue purely on the basis of calculated isotropic coupling constants, and it is shown, by comparing the experimental tensor components with those calculated by an ab initio M.O. procedure for N_3 and N_3^{2-}, that the N_3^{2-} formulation is far superior. (auth)

24290 UNSTABLE INTERMEDIATES. 131. An Electron Spin Resonance Study of a Range of Radicals in Irradiated Phenylphosphonic Dichloride and Phenylphosphonothionic Dichloride. Mishra, S. P.; Symons, M. C. R. (Univ. of Leicester, Eng.). J. Chem. Soc., Dalton Trans.; No. 14, 1494-1497(1973).

Exposure of the title compounds, $PhP(O)Cl_2$ and $PhP(S)Cl_2$, to ^{60}Co γ-rays at 77°K gave initially ESR spectra characteristic of the corresponding radical anions. Doublets of lower intensity were assigned to PhP(O)Cl and PhP(S)Cl radicals, the latter being clearly derived from the parent anions. Alone or in various solvents, the oxy-compound gave Cl_2^- on annealing, whereas the sulfur analogue gave PhP(S)Cl radicals. The electronic structures of these four phosphorus radicals are discussed in the light of the ESR data. In both cases, the pure compounds gave, on annealing, a species characterized by doublets separated by ca. 1400 G. For dilute solutions in a range of solvents, these species were not formed, and for this and other reasons it was concluded that they are radical dimers containing two equivalent or nearly equivalent phosphorus atoms. Possible structures are discussed. (auth)

24291 ELECTRON SPIN RESONANCE IDENTIFICATION OF PHOSPHORUS-CENTRED RADICALS IN γ-IRRADIATED DIALKYL

PHOSPHITES. Kerr, C. M. L.; Webster, K.; Williams, F. (Univ. of Tennessee, Knoxville). Mol. Phys.; 25: No. 6, 1461-1464(Jun 1973).

Unambiguous ESR identification of phosphorus-centred radicals in unoriented samples of γ-irradiated phosphorus esters at low temperatures is possible only in exceptional cases. This is because the ESR spectra generally consist of a superposition of anisotropic ^{31}P doublets from several different radicals. The present note describes how the spectroscopic assignments can be aided by simple radiation-chemical experiments designed to separate spectral features and to distinguish between mechanisms of radical formation. The general method employed is to study not only the bulk esters, but also glassy solutions (i) of an alkyl bromide in each ester and (ii) of each ester in 2-methyltetrahydrofuran (MTHF). These solutions show complementary behavior on γ irradiation, products of electron attachment being suppressed in the former and enhanced relative to other paramagnetic products from the ester in the latter. This is in accord with the properties of alkyl bromides as extremely efficient electron scavengers and of MTHF as a suitable matrix for the stabilization of anionic species by electron attachment. (UK)

24292 EFFECT OF IONIZING RADIATION ON PROTEINS IN WATER SOLUTION. Schuessler, H. (Erlangen-Nuernberg Univ., Erlangen, Ger.). Biophysik; 9: No. 4, 315-324(1973). (In German).

From annual meeting of the Deutsche Gesellschaft fuer Biophysik; Erlangen, Germany (4 Oct 1972).

The development in radiation research on proteins is reviewed from the early work of Fricke and Dale up to the modern radiation biology. Radioinduced changes in the conformation of the molecules were made evident by using modern techniques in protein chemistry. New results in radiation chemistry try to explain these changes by the reaction of the primary products of water radiolysis with the proteins. The rate constants for the reaction of water radicals with amino acids and proteins can be measured by pulse radiolysis. It was shown by experiment with scavengers that the inactivation process is mainly due to the reaction of OH radicals and not to the solvated electrons though they cause the destruction of cystine. (GE)

24293 EFFECT OF IRRADIATION ON THE CATALYTIC PROPERTIES OF A MIXTURE OF CRYSTALLINE FORMS OF NEODYMIUM OXIDE IN THE OXYGEN ISOTOPIC EXCHANGE REACTION. Mitrofanova, G. N.; Sazonov, L. A.; Preobrazhenskaya, L. V.; Sokolovskii, V. D. (Inst. of Catalysis, Novosibirsk, USSR). Kinet. Katal.; 14: No. 3, 623-626(1973). (In Russian).

The effect of irradiation on the catalytic properties of neodyium oxide in crystalline form, cubic (C) and hexagonal (A), and also in mixtures of these forms was investigated in oxygen isotopic exchange reactions. It was found that an increase in the concentration of form A in the sample leads to increased catalytic activity and increase of the effect of the irradiation because of the formation of a significant number of oxygen vacancies during high-temperature vacuum processing. (tr-auth)

24294 ROLE OF OH RADICALS IN THE RADIOLYSIS OF AQUEOUS DEOXYRIBONUCLEIC PROTEIN SOLUTIONS. Sharpatyi, V. A.; Zakatova, N. V.; Minkhadzhidinova, D. R.; Yarovaya, S. M.; Kudryashov, L. I. (Inst. of Chemical Physics, Moscow). Izv. Akad. Nauk SSSR, Ser. Khim.; No. 5, 1165-1166(May 1973). (In Russian).

A comparative study was made of the yield of the radiolysis products of deoxyribonucleic protein complexes, DKN, and histone albumin (hydrogen peroxide compounds, H_2O_2, NH_3, malonic dialdehydes, deoxy- and deoxyketo sugars). Propyl gallate and myoinosite, appearing as the acceptors of the OH radicals, reduce to a significant degree the yield of the radiolytic decomposition of the investigated biopolymer in aqueous solutions. (tr-auth)

24295 POLY(ETHYLENE/CHLOROTRIFLUOROETHYLENE) AND POLY(ETHYLENE/TETRAFLUOROETHYLENE) HAVING IMPROVED HIGH TEMPERATURE PROPERTIES. Carlson, D. P.; West, N. E. (to E. I. du Pont de Nemours and Co.). U. S. Patent 3,738,923. 12 Jun 1972. Filed date 19 Nov 1968. 12p.

The subjecting of poly(ethylene–tetrafluoroethylene) and poly(ethylene–chlorotrifluoroethylene) to a moderate amount of ionizing radiation has the effect of improving the tensile properties, especially ultimate elongation, of the copolymers at elevated temperatures. The amount of radiation required to obtain this improvement is minimized by following the radiation treatment with heat treatment of the copolymer. (auth)

24296 POLYMERIZATION OF METHYL METHACRYLATE BY HEAT-CATALYST AND GAMMA-IRRADIATION METHODS. Beall, F. C. (Pennsylvania State Univ., University Park); Witt, A. E. Wood Fiber; 4: No. 3, 179-184(Fal 1972).

Methyl methacrylate (MMA) was bulk-polymerized with 0 to 4% crosslinker (ethylene glycol dimethacrylate, EGDM, and trimethylol propane trimethyacrylate, TMPTM), initiated with 0.05 to 5% catalyst (Vazo) at 65 to 75°C or 0.1 to 1 Mrad/hr gamma radiation at 20°C. Heat-catalyzed MMA conversion to polymer vs. time was obtained directly from polymer mass, which indicated that about 90% conversion had occurred at the exothermic peak temperature. The time to the exothermic peak temperature was used to determine sample polymerization time. The over-all polymerization rate varied with the half-power of initiator concentration. An Arrhenius plot of the initiator-time data gave an activation energy of 18 kcal/mole. A log–log relationship was found between crosslinker concentration and polymerization time over the 65 to 75°C temperature and 0.1 to 0.4% initiator range. The crosslinkers were found equally efficient in reducing polymerization time. Peak exothermic temperature varied directly with time, irrespective of the initiator and crosslinker concentrations or bath temperature, except as they affected time. In the irradiation tests, the crosslinkers exhibited different data fits: log–log with EGDM and semilog for TMPTM. The time-dose rate equation for uncrosslinked MMA was analogous to that for heat-catalyzed polymerization. Molecular weight of uncrosslinked PMMA was determined as a function of temperature and catalyst concentration, and dose rate. Similar molecular weights were obtained for heat-catalyzed polymerization at 65°C and gamma irradiation at 20°C for numerically the same initiator concentration (%) and dose rate (Mrad/hr). (auth)

24297 HYDROPEROXY RADICAL IN AQUEOUS SOLUTIONS. Czapski, G. (Hebrew Univ., Jerusalem). Israel J. Chem.; 10: No. 6, 987-997(1972).

Various methods of generating the hydroperoxy radical, including radiolysis, photolysis, and chemical reactions, are described. Both chemical and physical properties of the radical are summarized. The features of complexes of HO_2 with various cations, including U^{6+} and Th^{4+}, their fast exchange, and their possible role in biological systems are discussed. (auth)

24298 ELECTRON SPIN RESONANCE STUDIES OF DECOMPOSITION INTERMEDIATES IN STRONTIUM AND BARIUM NITRATES, INCLUDING PYROLYTICALLY PRODUCED NO_3^{2-}. Harrison, L. G.; Ng, H. N. (Univ. of British Columbia, Vancouver). J. Chem. Soc., Faraday Trans., I; 69: No. 8, 1432-1439(1973).

$Sr(NO_3)_2$ and $Ba(NO_3)_2$, melt-recrystallized and partly decomposed, gave an esr spectrum assigned to NO_3^{2-}, with hyperfine splitting slightly different from that of NO_3^{2-} in x-irradiated $Sr(NO_3)_2$. The Ba compound showed additional lines attributable to a single Ba nucleus. The NO_3^{2-} apparently resides in the decomposition product, $SrCO_3$ from atmospheric CO_2. It is proposed that NO_3^{2-} is a decomposition intermediate in nitrate melts. X-irradiated $Sr(NO_3)_2$ showed, at 296°K, signals attributed to NO_2 and O_3^-, in conformity with the work of Ždánský and Šroubek (Czech. J. Phys.; B14: 121(1964)), except that their assignments of $g_{\parallel}$ and $g_{\perp}$ in O_3^- are reversed. Irradiation at 77°K did not yield NO_3^{2-} as reported by Ždánský and Šroubek (Phys. Stat. Sol; 7: 167 (1964)) for 90°K, but gave a spectrum which is probably that of NO_3. (auth)

24299 EFFECT OF THE PRESENCE OF THORON DAUGHTERS ON THE MEASUREMENT OF RADON DAUGHTER CONCENTRATIONS. Strong, J. C.; Duggan, M. J. (National Radiological Protection Board, Harwell, Eng.). Health Phys.; 25: No. 3, 299-300(Sep 1973).

When Kusnetz's method of measuring radon daughter concentrations (Am. Ind. Hyg. Ass. Quart.; 17: 85(1956)) is used, the error arising from the presence of thoron daughters in the sampled atmosphere becomes more important as the delay between sampling and counting increases. First the error due to radon daughter disequilibrium is considered. Decay curves for the daughter alpha activity for two values of the RaA, RaB, and RaC concentrations viz. 1:1:1 and 1.0:0.15:0.06, up to an elapsed time of 300 min, were derived. It is shown that the error due to the state of daughter equilibrium is not more than 10%. More serious errors are introduced by the presence of thoron daughters. These were calculated and are shown by tabulation of the alpha activity due to radon daughters and that due to thoron daughters at a number of times after sampling. From the figures it was found that it is desirable to allow for ThB concentration when calculating the radon daughter concentration if the time between sampling and counting is greater than 3 hr. (UK)

24300 PHOTOCHEMISTRY. Volume 4. A Review of the Literature Published Between July 1971 and June 1972. Bryce-Smith, D. (ed.). Specialist Periodical Report. London; Chemical Society (1973). 992p.

The subject is dealt with in four parts. In the first part, on physical aspects of photochemistry, the chapters cover: spectroscopic and theoretical aspects; developments in instrumentation and techniques; photochemical processes in condensed phases; and gas-phase studies. The second part, on inorganic photochemistry, covers: theoretical and spectroscopic studies; photochemistry of H_2O, H_2O_2, inorganic anions, and the hydrated electron; photoluminescence and photochemistry of metal complexes (including uranium complexes); photochemistry of organometallic and non-metallic systems and gas-phase studies; and properties of solids, including phosphors. The third part deals with organic aspects of photochemistry. The fourth part deals with polymer photochemistry. (UK)

24301 ACTIVE SPECIES IN RADIATION-IRRADIATED POLY(VINYL ALCOHOL) FOR INITIATION OF GRAFT POLYMERIZATION. Yoshitake, T. (Kuraray Co. Ltd., Okayama, Japan). Nippon Kagaku Kaishi; 1973: No. 6, 1242-1244(Jun 1973). (In Japanese).

Yields of trapped radicals in radiation-irradiated poly(vinyl alcohol) (PVA) has already been measured quantitatively in terms of ESR and reported. However, when vinyl monomer was graft polymerized onto irradiated PVA, some of the trapped radicals seemed to become partially effective for the initiation of graft polymerization, and the remaining trapped radicals were inactivated by the side-reaction, e.g., a recombination of radical and an attack of residual oxygen in this system. Studies of this phenomenon are reported. A DPPH radical was allowed to react with irradiated PVA under the condition similar to graft polymerization. The amount of trapped PVA radical that seemed to initiate effectively graft polymerization was estimated from the amount of consumed DPPH radical. This value was about a tenth of that obtained in terms of ESR. (auth)

24302 KINETICS OF DISAPPEARANCE OF HYDROGEN ATOMS IN γ IRRADIATED GLASS-LIKE HYDROCHLORIC ACID SOLUTIONS. Gorbovitskaya, T. I.; Belevskii, V. N.; Bugaenko, L. T. Vestn. Mosk. Univ., Ser. II. Khim.; 14: No. 2, 163-166 (1973). (In Russian).

The kinetics of the disappearance of hydrogen atoms in γ-irradiated glass-like hydrochloric acid solution was studied by ESR technique at 77 and 90°K. The decay curves were shown to be described as logarithmic functions of time. The energies of activation of the hydrogen atoms disappearance were determined. (auth)

24303 KINETICS OF HYDROGEN ISOTOPE EXCHANGE REACTIONS. 22. Reactivity Comparisons for a Series of Aromatic Substrates Towards Radiolytically Generated Tritium Atoms in Aqueous Solution. Brett, C. L.; Gold, V. (King's Coll., London). J. Chem. Soc., Perkin Trans., II; No. 10, 1437-1450(1973).

The relative reactivities of a series of aromatic compounds towards tritium atoms, generated by β-radiolysis, have been determined in degassed aqueous solution by a competition method, involving copper(II) ions as common competitor in the radiation-induced aromatic hydrogen exchange. Under these conditions, steps subsequent to the formation of the cyclohexadienyl radical are not kinetically significant. It is shown that comparable doses of γ-irradiation induce an equivalent extent of exchange. From the effect of low concentrations of copper(II) ions on the β-radiation-induced exchange rate it is concluded that the reversion of the intermediate cyclohexadienyl radical to aromatic compound normally involves an oxidation step and that bimolecular radical-radical reactions are unimportant. The rates of tritium atom attack relative to benzene are: mesitylene, 8.5; toluene, 2.2; anisole, 2.7; fluorobenzene, 1.0; chlorobenzene, 1.1; bromobenzene, 1.1; benzonitrile, 0.9; trifluoromethylbenzene, 0.35; and t-butylbenzene, ca. 2 to 4. Because of an intramolecular kinetic isotope effect, the rate of radiation-induced tritium uptake by mesitylene is ca. 1.5 ± 0.2 times larger than that by [2,4,6-$^2H_3$] mesitylene. The extinction coefficients at the u.v. absorption maxima for these substrates in aqueous solution have been redetermined. The solubility of t-butylbenzene in water at 25° was found to be $(1.9 \pm 0.1) \times 10^{-2}$ g dm^{-3}. The rate constant for the reaction of hydrogen (tritium) atoms with iodide ion is ca. 5.5×10^7 dm^3 s^{-1} mol^{-1}. (auth)

24304 RADICALS FORMED FROM ACETYLENES BY HIGH ENERGY RADIATION AND HYDROGEN ATOM BOMBARDMENT. An Electron Spin Resonance Study. Neilson, G. W.; Symons, M. C. R. (Univ. of Leicester, Eng.). J. Chem. Soc., Perkin Trans., II; No. 10, 1405-1410(1973).

A variety of acetylenic compounds, including acetylenedicarboxylic acid, its salts, and its dimethylester, propiolic acid and its salt, mono- and di-phenylacetylene, phenylpropiolic acid, propargyl chloride and bromide, and 1,4-dichlorobut-2-yne were exposed to ^{60}Co γ-rays at 77°K, and the radical products at 77°K and during annealing have been studied by ESR spectroscopy. Several of these compounds were also exposed to beams of hydrogen or deuterium atoms and again examined by ESR spectroscopy at 77°K. Radicals thus identified include hydrogen atom addition products, $R^1\dot{C}H = CR^2$, several of which are thought to be linear at the radical center, rather than being bent as in the parent vinyl radical. Curiously, dipotassium acetylenedicarboxylate gave, on exposure to γ-rays at 77°K, $H_2C = \dot{C}CO_2^-$ radicals. On annealing, new radicals were detected which in several instances were probably dimers formed by addition of the parent radicals to neighbouring acetylene monomers. Other radicals identified include $HC \equiv C\dot{C}H_2$, $H_2C = \dot{C}Ph$, $HC \equiv C\dot{C}HCl$, and $HC \equiv C\dot{C}HBr$. (UK)

24305 EFFECT OF METAL CARBONYLS ON THE α-RADIOLYSIS OF CARBON MONOXIDE. Baird, T. (Univ. of Glasgow). Carbon; 11: No. 3, 252-254(Jun 1973).

Further experiments were conducted on the effect of metal carbonyl impurities in CO in counteracting the inhibiting effect of oxygen upon the formation of solid products during the decomposition of CO by ionizing radiations. A brief description is given of radiolysis experiments in CO, containing oxygen, using a ^{240}Pu/Al alloy α source at dose rate of $\sim 2 \times 10^{12}$ eV sec^{-1} in the presence of $Fe(CO)_5$ and $Ni(CO)_4$. Results are discussed. (UK)

24306 EFFECT OF LOW-LEVEL RADIOACTIVE SILVER ON PHOTOGRAPHIC EMULSIONS. Ehn, E.; Lundh, A.; Staaf, O. Nature (London); 243: No. 5408, 460(22 Jun 1973).

The detection of low levels of radioactivity in silver bullion bars has been reported. Because this silver may be used in the manufacture of photographic emulsions the effects of the radioactivity were obviously of concern to photographic film manufacturers. The storage of photographic materials containing silver of the reported radioactivity level of 10^{-4} μCi/g silver is here considered. (auth)

24307 RADIATSIONNAYA KHIMIYA POLIMEROV. (Radiation Chemistry of Polymers). Kargin, V. A. (ed.). Moscow; Izdatel'stvo Nauka (1973). 456p.

The latest achievements in the area of the radiation chemistry of polymers are discussed. Contemporary concepts on the mechanism of radiation chemical processes in different systems, structural changes, and the properties of polymer material under the influence of ionizing radiation are reported. The basic laws of radiation polymerization in the liquid state at low temperatures and in two-phase eutectic systems and polymerization in the solid state are examined. The general characteristics of the processes of radiation grafting polymerization and the regularity of the grafts in the gaseous phase are discussed. The radiation chemical conversion of polyolefin is described. The characteristics of the thermal oxidation of radiation modified polyolefins are discussed. The basic radiation chemical effects in elastomers are examined. Reversible radiation effects in polymers are considered. (tr-auth)

24308 KINETICS OF HYDROGEN ISOTOPE EXCHANGE REACTIONS. 23. Isomer Distributions in the Radiation-Induced Tritiation of Benzene Derivatives in Aqueous Solution. Brett, C. L.; Gold, V.; Perez, G. (King's Coll., London). J. Chem. Soc., Perkin Trans., II; No. 10, 1450-1453(1973).

The isomer distribution of aromatic tritiation induced by γ irradiation of solutions of aromatic compounds (anisole, toluene, chlorobenzene, and fluorobenzene) in tritiated water was examined by nitration of the reaction product, separation, and tritium assay of the isomeric mononitration products. In toluene and anisole, ca. 70% of tritium atom attack occurs at ortho-positions; in the two halogenobenzenes the attack appears to be approximately statistical. (auth)

24309 RADIOTHERMOLUMINESCENCE OF DNA AND COMPOUNDS SIMULATING INDIVIDUALLY ITS FRAGMENTS IN MATRICES BASED ON PHOSPHATE IONS (IN FROZEN SOLUTIONS OF H_3PO_4 AND NaH_2PO_4. Sultankhodzhaeva, M. N.; Sharpatyi, V. A. (Inst. of Chemical Physics, Moscow). Izv. Akad. Nauk SSSR, Ser. Khim.; No. 6, 1254-1260(Jun 1973). (In Russian).

The radiothermoluminescent yield of frozen solutions of H_3PO_4 and sodium hydrogen phosphate is shown. The origin of the luminescent peaks in these solutions is connected with the recombination of the components of the radiolysis of water or products of their conversion. Nitrous bases introduced into these matrices, glucose, and DNA emerge in the nature of quenchers or luminescent activators and radical accenters. (tr-auth)

24310 REMOTE CONTROLLED DEAERATION TECHNIQUE FOR RADIATION CHEMICAL STUDIES. Bhattacharyya, P. K.; Saini, R. D.; Ponkshe, M. R. (Bhabha Atomic Research Centre, Bombay). Int. J. Appl. Radiat. Isotop.; 24: No. 9, 493-496(Sep 1973).

A simple apparatus is made to deaerate or saturate a solution by a particular gas for the purpose of radiation and photochemical studies. Both deaeration and introduction of the deaerated solution into a suitable cell without being contaminated with oxygen are

carried out by means of electronically controlled solenoid valves, making the apparatus useful for radioactive solutions. The apparatus is tested for a deaerated Fricke dosimeter solution. (auth)

24311 FORMATION AND ANNEALING OF FREE RADICALS CREATED IN IRRADIATED CHLORATES. Vargas, H.; Dimitropoulos, C.; Constantinescu, O.; Dautreppe, D. (CEN, Grenoble, France). Radiat. Eff.; 18: No. 1-2, 9-12(Mar 1973).

A systematic study of the thermal annealing of irradiated $NaClO_3$ and $KClO_3$ was made by EPR and NQR techniques. The irradiation conditions, the physical state of the sample, and the impurities therein were shown to influence the formation and destruction of the free radicals created by the irradiation. The experimental results are in good agreement with a proposed model. (auth)

24312 FREE SOLVATED ELECTRON IN HEXAMETHYLPHOSPHORIC TRIAMIDE. Dodin, G.; Dubois, J. E. (Univ., Paris). J. Phys. Chem.; 77: No. 20, 2483-2487(27 Sep 1973).

The width of the ESR narrow line from the solvated electron in hexamethylphosphoric triamide (HMPA) – sodium solutions arises from exchange narrowing and the activation energy for the hyperfine coupling modulation as well as the volume of the solvated electron increase with increasing solvent viscosity. When the viscosity is extrapolated to zero, the line width has a nonzero value resulting presumably from electron-nuclear spin dipolar coupling. The resonance line in the ideal nonviscous state might be attributed to a species we shall refer to as a "free" solvated electron which would consist of an electron trapped in a cavity formed by a layer of solvent molecules. The contributions to the experimental line width variation from both viscosity effects and technological artifacts arising from cavity shifts and 100-kHz modulation are easily differentiated provided certain experimental conditions are satisfied. (auth)

24313 REACTION OF HYDROXYL RADICALS WITH POLYETHYLENE OXIDE IN AQUEOUS SOLUTION. Matheson, M. S.; Mamou, A.; Silverman, J.; Rabani, J. (Hebrew Univ., Jerusalem). J. Phys. Chem.; 77: No. 20, 2420-2424(27 Sep 1973).

In aqueous solutions the rate constant for OH + polyethylene oxide depends upon the concentration and upon the molecular weight of the polymer. If the rate is expressed as "k_M"(OH)(M), where (M) is the concentration of polymer in monomer units, "k_M" varies with $x^{-0.4}$ (x = degree of polymerization) in dilute solutions where polymer molecules are isolated from each other. In concentrated solutions ((M) $\gtrsim$ 1 M) where polymer molecules essentially fill all of the solution, "k_M" is independent of x and is the same as the rate constant "k_M" for polymer of x = 3 or 4. For polymer of x = 3 or 4 "k_M" is independent of (M). Experimentally, "k_M" was evaluated for polyethylene oxide polymers of different x's and concentrations in pulse radiolysis competition experiments using ferrocyanide and iodide as OH scavengers. An equation was also developed from polymer solution theory and probability theory which gives the appropriate correlation of "k_M" with (M) and with x. (auth)

24314 HYDROXYL RADICAL REACTION WITH PHOSPHATE ESTERS AND THE MECHANISM OF PHOSPHATE CLEAVAGE. Samuni, A.; Neta, P. (Carnegie-Mellon Univ., Pittsburgh). J. Phys. Chem.; 77: No. 20, 2425-2429(27 Sep 1973).

The reaction of hydroxyl radicals with several phosphate esters in irradiated aqueous solutions was followed by ESR observation of the radicals and by determination of the yield of inorganic phosphate. The initial step of hydrogen abstraction takes place at all available C-H positions and, as expected, the site of reaction was found to be affected by the state of protonation of an amino group. In most cases the radicals produced by abstraction were observed by ESR and in certain cases the radicals subsequently produced by elimination of H_2O or H_3PO_4 were also observed. The results for phospho glycols indicate that α-phospho radicals are most stable toward phosphate elimination but that β-phospho radicals undergo elimination of H_3PO_4 very rapidly. Elimination of H_2O from these and other radicals appears to be slower than that of H_3PO_4. The results for ethanolamine and serine phosphates indicate that the elimination of H_3PO_4 from the radicals is slower than in the case of glycol phosphates and probably does not take place at all when the amino group is protonated. (auth)

24315 ELECTRON PARAMAGNETIC RESONANCE OF FREE RADICALS IN AN ADAMANTANE MATRIX. VI. The Hexafluorobenzene Anion Radical. Williams, L. F.; Yim, M. B.; Wood, D. E. (Univ. of Connecticut, Storrs). J. Amer. Chem. Soc.; 95: No. 19, 6475-6477(19 Sep 1973).

The EPR spectrum of hexafluorobenzene anion radical, produced by 50 kV x irradiation at 77°K of an adamantane matrix containing ~0.05% hexafluorobenzene and a somewhat larger amount of trimethylamine–borane, shows six equivalent fluorine nuclei with a_F = 137 G and g = 2.0015. These fluorine hyperfine splitting constants (hfs) are about ten times larger than would be expected for a π radical based upon all previous results for fluorinated benzyl radicals, fluorinated aromatic cation radicals, and fluorinated aromatic anion radicals. This strongly suggests that the electronic structure of $C_6F_6^-$ is better described as a σ radical than as a π radical. (DHM)

24316 KINETICS OF THE SCISSION OF THE FUNCTIONAL GROUPS OF ION-EXCHANGE RESINS. VIII. Thermal and Radiation Stability of Ankalit KT-3 Sulphonic Acid Cation Exchange Resin in Water. Tulupov, P. E. Russ. J. Phys. Chem. (Engl. Transl.); 47: No. 2, 194-197(Feb 1973).

Translated from Zh. Fiz. Zhim.; 47: No. 2, 344-348(Feb 1973).

The sulfo-groups of Ankalit KT-3 cation-exchange resin are equivalent as regards susceptibility to thermal hydrolysis and are eliminated in accordance with the kinetic equation for second-order reactions with an activation energy of 37.0 kcal $mole^{-1}$ and a pre-exponential factor of 7.5×10^{16} kg matrix $mole^{-1}$ h^{-1} in the Arrhenius equation. When the resin is irradiated, desulfonation takes place in preference to inactivation to the sulfo-groups. The kinetics of the overall process are described by the equation for second-order reactions with a rate constant of 1.62×10^{-10} kg matrix $mole^{-1}$ rad^{-1}. The problem of the state of water in the resin phase and the criteria for the assessment of the degradation of the matrix are discussed. (auth)

24317 FORMATION OF THE AZIDE RADICAL DURING THE PULSE RADIOLYSIS OF PURE NITROGEN AND NITROGEN MIXTURES. Dreyer, J. W.; Perner, D. (Kernforschungsanlage, Juelich, Ger.). Ber. Bunsenges. Phys. Chem.; 77: No. 6, 442-447(1973). (In German).

The N_3^- radical is formed upon irradiation of nitrogen by 600 keV electron pulses with a yield of about 0.2 per 100 eV absorbed energy. The yield increases to about 1.5 in mixtures of nitrogen with small amounts of additives like ammonia, cyclopropane, n-butane. The kinetics of the N_3^- formation is followed by absorption spectroscopy and a simple reaction scheme is proposed. (auth)

Radiochemistry and Nuclear Chemistry

24318 (AEC-tr-7226/1-2) NUKLEONIKA, VOL. 17, NO. 1-2, 1972. Translation of Nukleonika; 17: No. 1-2, 1-144(1972). 128p. (TT-71-54027/1-2). Dep. NTIS $5.45.

Hot-Atom Chemistry

Refer also to abstract 24208.

24319 SIMPLE AND EFFECTIVE METHOD FOR THE PURIFICATION OF CALIFORNIUM FROM OTHER ELEMENTS. Guseva, L. I.; Myasoedov, B. F.; Tikhomirova, G. S.; Pavlenko, L. I.; Babicheva, G. G. (Inst. of Geochemistry and Analytical Chemistry, Moscow). J. Radioanal. Chem.; 13: No. 2, 293-300(Feb 1973).

The distribution coefficients of californium and other elements between an anion exchange resin and alcohol solutions of nitric acid of different concentrations were determined. An effective method is suggested for the purification of californium from other elements that are slightly adsorbed when Cf is concentrated on an anion exchanger from 0.5 to 1.0N solutions of nitric acid containing 95 to 90% alcohol; Cf is subsequently eluted with a 0.5N HNO_3 solution in 85% CH_3OH and simultaneously separated from the elements which are strongly adsorbed on the anion exchange resin. Under the chosen conditions the coefficients of californium purification were determined for a number of elements; the values are 5.4×10^2 to 1.8×10^3 for Al, Ca, Fe and ~10^3 to 10^5 for Am, Pm, Nd, Ce, Pb, Bi, and Na, for one cycle. (auth)

24320 MULTICOLUMN RADIO-GAS CHROMATOGRAPHIC ANALYSIS OF RECOIL TRITIUM REACTION PRODUCTS. Fee, D. C.; Markowitz, S. S. (Univ. of California, Berkeley). Anal. Chem.; 45: No. 11, 1827-1831(Sep 1973).

A general radio-gas chromatographic analysis system was developed for hydrogen and C_1 to C_7 alkanes and alkenes. Peaks were monitored at a constant flow rate in the same detector (a β proportional counter) and the injection volume was large. A system of four columns used in series gave adequate resolution of more than 20 products from the whole sample. This system was a combination of stop-flow, recycle, center-cut, stepwise temperature programming, and stepwise pressure programming techniques. (auth)

24321 GAS PHASE RECOIL PHOSPHORUS REACTIONS. 1. Complete and Partial Retention of Bonds in PF_5. Gennaro, G. P.;

Tang, Y. N. (Texas Agricultural and Mechanical Univ., College Station). J. Inorg. Nucl. Chem.; 35: No 9, 3087-3094(Sep 1973).

Phosphorus pentafluoride vapor was exposed to thermal neutrons in systems with and without various additives. Ethylene, proved to be an efficient scavenger in this system, permitted the determination of primary retentions of $^{32}PF_5$ and $^{32}PF_3$ after radiative neutron capture, which represent the probabilities of survival of 5 bonds and 3 bonds respectively. The partial retention of 3 bonds (1.34%) is much larger than the complete retention (0.08%) and is discussed in terms of factors which may promote partial bond survival in molecules with multivalent transformed atoms. (auth)

24322 CHEMICAL EFFECTS ASSOCIATED WITH THE (n,γ) REACTION IN DIPHENYLTELLURIUM BOTH PURE AND IN SOLUTION. Thomas, A.; Llabador, Y. (Univ. Louis Pasteur, Strasbourg). Radiochem. Radioanal. Lett.; 14: No. 5-6, 333-340 (5 Sep 1973). (In French).

The organic yields of ^{127}Te, ^{129}Te, and ^{131}Te formed during neutron irradiation of diphenyltellurium neat and in benzene and carbon disulfide solutions were determined. No isotope effect was observed. In diluted solutions the very low value of the retention indicates that in all cases the molecule is broken after the (n,γ) process. The results in benzene are interpreted in terms of energy transfer reactions while in carbon disulfide, the proposed mechanism involves an isotopic exchange reaction between the inorganic recoil tellurium and diphenyltellurium. (auth)

24323 RELATIVE REACTIVITIES OF CARBON–CARBON SINGLE BONDS IN NORMALIZED RECOIL TRITIUM SYSTEMS. Williams, J. L.; Daniel, S. H.; Tang, Y. N. (Texas A and M Univ., College Station). J. Phys. Chem.; 77: No. 20, 2464-2468(27 Sep 1973).

Recoil tritium atoms were allowed to react with 14 different hydrocarbons, including alkanes, alkenes, and alkynes, in hexafluorocyclobutene-normalized systems. The relative CH_3T yields per bond from the hot tritium abstraction of end methyl groups were correlated inversely with the R-CH_3 bond dissociation energies. The electron density around the reaction site showed no obvious effect on CH_3T yields. The reaction time for this type of interaction is likely to be less than $2\text{-}5 \times 10^{-14}$ sec. Possible mechanisms for the formation of CH_3T are discussed. (auth)

24324 SEPARATION OF THE RECOIL PRODUCTS OF Ra-224- AND Cf-252-SOURCES BY FORMATION OF ALKYL COMPOUNDS. Hoffmann, P.; Baechmann, K.; Klenk, H.; Trautmann, W.; Lieser, K. H. (Technische Univ., Darmstadt, Ger.). (1973). vp. (In German).

From meeting of the Gesellschaft Deutscher Chemiker on trace analysis; Erlangen, Germany (2 Apr 1973).

The conversion of the ^{224}Ra decay products ^{212}Pb, ^{212}Bi, and ^{208}Tl to volatile alkyl compounds makes it possible to separate these radionuclides from a ^{224}Ra source and to determine their yield. In the method presented, modification of a procedure described earlier, $Pb(C_2H_5)_4$ is decomposed in order to produce ethyl radicals which then react with the recoils of the source. The ethyl products formed are transported in a described apparatus to a detector where they are decomposed and where the single nuclides are precipitated and measured. The influencing parameters are discussed. Furthermore, first experiments as to a selective separation of fission products from a ^{252}Cf source via volatile alkyl compounds are described. (GE)

Properties of Radioactive Materials

Refer also to abstracts 24165, 24180, 24181, 24184, 24297, 24300, 24897, and 24932.

24325 (BMFT-FBK-73-15) DECONTAMINATION OF DIFFERENT AEROSOL-CONTAMINATED SURFACES. Stoeckert, H.; Appler, K.; Schroeder, P. (Siemens A. G., Erlangen (West Germany)). Jun 1973. 40p. (In German). Dep. NTIS (U. S. Sales Only) $4.00.

In the reactor vessel and in the fuel element pit of the Mehrzweckforschungsreaktor (MZFR), Karlsruhe, several coated and metallic samples were contaminated. The exposure in the reactor vessel was 39 months and in the fuel element pit 15 months. In the reactor vessel the samples made of austenitic stainless steel showed a higher contamination than the coated samples. However, in the fuel element pit the activity on the coated samples was higher than on the metallic surfaces. The most successful decontamination method was to "spray and brush". (auth)

24326 (CEA-CONF-2281) OXIDATION STATES (V) OF URANIUM AND TRANSURANIC ELEMENTS. Musikas, C. (Commissariat a l'Energie Atomique, Fontenay-aux-Rosés (France). Centre d'Etudes Nucleaires). 1972. 7p. (In French). (CONF-711228-1). Dep. NTIS (U. S. Sales Only) $3.00.

Two different, but characteristic aspects of the pentavalent oxidation states of uranium and the transuranic elements are presented. They are ionic forms and their stability in aqueous solution and peroxidized complexes is described. (FR)

24327 (CONF-730309-10) SYNTHESIS AND EVALUATION OF ^{11}C-LABELED ORGANIC COMPOUNDS FOR USE IN NUCLEAR MEDICINE. Lin, T. H.; Khentigan, A.; Lamb, J.; Fleischer, A.; Winchell, H. S.; Winstead, M.; Myers, W. (Medi-Physics, Inc., Emeryville, Calif. (USA); Bucknell Univ., Lewisburg, PA. (USA); Ohio State Univ., Columbus). [nd]. Contract AT(04-3)-849. 14p. (SM-171/36). Dep. NTIS $3.00.

From symposium on new developments in radiopharmaceuticals and labelled compounds; Copenhagen, Denmark (26 Mar 1973).

Large quantities of ^{11}C labeled compounds can be synthesized and their in vivo distribution imaged by γ scintigraphy using positron cameras, rectilinear scanners or γ cameras using high energy multihole or pinhole collimators. Organic compounds which are not normal body constituents are usually excreted from the body by the kidneys or the liver with excretion products appearing in urine or bile respectively. The results do not differentiate between direct excretion by these organs or excretion after conjugation or alteration in the body. In general compounds containing polar moieties and possessing high water solubility are largely excreted by the kidneys while those compounds containing nonpolar, lipid soluble moieties, are largely excreted by the liver. Whether the liver or kidney is the organ most responsible for excretion of a given compound also depends upon its degree of in vivo conjugation, a parameter which was not measured. (auth)

24328 (ORNL-4891) CHEMISTRY DIVISION ANNUAL PROGRESS REPORT FOR PERIOD ENDING MAY 20, 1973. Moore, G. E. (ed.). (Oak Ridge National Lab., Tenn.). Sep 1973. Contract W-7405-eng-26. 180p. Dep. NTIS $7.60.

Research progress is reported in the following areas: nuclear chemistry, chemistry and physics of transuranium elements, isotope chemistry, radiation chemistry, organic chemistry, physical chemistry, and chemical physics. (DHM)

24329 DETERMINATION OF DISTRIBUTION AND STABILITY CONSTANTS OF AMERICIUM AND CURIUM CHELATES WITH AROMATIC SCHIFF-BASES. XV. Radiotracer Studies on the Extraction of Metal Ions. Stronski, I.; Rekas, M. (Inst. of Nuclear Physics, Krakow). Radiochem. Radioanal. Lett.; 14: No. 5-6, 297-304(5 Sep 1973).

The distribution ratio D of tervalent americium and curium salts between 0.1 M bis-salicylidenealdehydeethylenediimine (BSEDI) or 0.1M bis-3-methoxysalicylidenealdehydeethylenediimine (B-3-MoxSEDI) in chloroform and aqueous phase was investigated in dependence of pH in order to determine the distribution and stability constants of the chelates formed. (auth)

24330 CHEMISTRY OF URANIUM. IV. Electronic Spectral Analysis of Some Six Coordinated Uranium(IV) Complexes: Theoretical Aspects. Du Preez, J. G. H.; Rossouw, W. J.; Wiechers, G. (Univ. of Port Elizabeth, S. Afr.). J. S. Afr. Chem. Inst.; 25: No. 4, 349-361(1972).

A simplified method for the electronic spectral analysis of octahedral uranium(IV) complexes according to an electrostatic LF model was developed. Ligand field basis functions were used instead of spin-orbit functions, simplifying the construction of the energy matrix, although the computational labor was greatly increased since the entire energy matrix (of order 91) had to be diagonalized. (auth)

24331 RADIONUCLIDIC AND RADIOCHEMICAL CONTROL OF RADIOPHARMACEUTICALS AT THE N.R.C. DEMOCRITOS. Beikas, E. P.; Archimandritis, S. (Nuclear Research Center Democritos, Athens). J. Radioanal. Chem.; 13: No. 2, 469-474 (Feb 1973).

In the production of ^{131}I, the presence of a contamination extractable with organic solvents was detected and its source discovered. Steps were taken to prevent further contamination. The influence of overheating was established in the preparation of ^{99m}Tc by the extraction method. Finally, details are given of the procedure used for the estimation of ^{193}Au present in ^{196}Au. (auth)

24332 STUDY OF THE SULPHATE COMPLEXING OF Np(IV) AND Pu(IV) BY SOLVENT EXTRACTION WITH DINONYL NAPHTHALENESULPHONIC ACID. Patil, S. K.; Ramakrishna, V. V. (Bhabha Atomic Research Centre, Bombay). J. Inorg. Nucl. Chem.; 35: No. 9, 3333-3340(Sep 1973).

The complex formation of Np(IV) and Pu(IV) with sulphate ions was studied in perchloric–sulphuric acid solutions at an ionic strength of 2.0 and $[H^+] = 2.0$ M by the distribution method using the liquid cation exchanger, dinonyl naphthalenesulphonic acid as

an extractant. Also the sulphate complexing of Pu(IV) in perchloric-sulphuric acid solutions was studied using the TTA extraction method. The values of the formation constants are compared with the literature values. (auth)

24333 CHEMISTRY OF URANIUM. V. Electronic Spectral Analysis of Some Six Coordinated Uranium(IV) Complexes: Application. Du Preez, J. G. H.; Rossouw, W. J.; Van Vuuren, C. P. J.; Wiechers, G. (Univ. of Port Elizabeth, S. Afr.). J. S. Afr. Chem. Inst.; 25: No. 4, 362-369(1972).

A theoretical spectral analysis was applied to a number of six co-ordinated halo-complexes of uranium(IV) ($UX_4.2L$ where X = Cl^- and Br^- and L = neutral oxygen donor ligand). Although significant differences in the ligand field and interelectronic parameters could be detected between chloro- and bromo- complexes, these were not significant for UCl_4 complexes (UBr_4 complexes) with different neutral oxygen donor ligands. (auth)

24334 OXIDE DISSOLUTION MECHANISMS. 3. Surface Activation in the System Uranium Dioxide–Sulphuric Acid. Shying, M. E. (Australian Atomic Energy Commission Research Establishment, Sutherland). J. Inorg. Nucl. Chem.; 35: No. 9, 3299-3305(Sep 1973).

A technique is described for the study of the dissolution kinetics of uranium dioxide in sulphuric acid. It is suitable for the investigation of other oxide-aqueous systems and eliminates many of the problems inherent in previous techniques. It provides accurate rate data and facilitates the observation of surface dissolution phenomena. High pH solutions activate uranium surfaces with respect to their rate of dissolution in acid solution. This activation increases with increasing alkali concentration and with increasing exposure time of the surface to the alkali. Such behavior is consistent with the hydroxyl dissociation mechanism for oxide dissolution. (auth)

24335 SOLVATION OF URANYL NITRATE BY TBP IN N-HEXANE BY VAPOR PRESSURE LOWERING MEASUREMENTS. Poczynailo, A.; Danesi, P. R.; Scibona, G. (Comitato Nazionale per l'Energia Nucleare, Casaccia, Italy). J. Inorg. Nucl. Chem.; 35: No. 9, 3249-3255(Sep 1973).

The solvation of uranyl nitrate by TBP in n-hexane was the subject of further investigation by vapor pressure lowering measurements. It was found that, if the deviations from ideality of the system are interpreted as arising from the establishment of chemical equilibria between the solutes, the data can be explained in terms of presence of a disolvate and trisolvate of $UO_2(NO_3)_2$ by TBP as well as monomeric and dimeric molecules of TBP. The following formation constants were calculated: $\beta_2 = 1.24 \pm 0.08$ ($2TBP \rightleftharpoons TBP$); $K = 3.7 \pm 1.0$ ($UO_2(NO_3)_2 \cdot 2TBP + TBP \rightleftharpoons UO_2(NO_3)_3 \cdot 3TBP$). (auth)

24336 TABLE FOR DETERMINATION OF SPECIFIC RADIOACTIVITY OF SAMPLES CONTAINING ^{14}C. Komisarenko, S. V. (Inst. of Biochemistry, Kiev). Ukr. Biokhim. Zh.; 45: No. 3, 367-368(1973). (In Ukrainian).

A table is compiled for calculating specific radioactivity of ^{14}C-containing samples in a gas-flow counter within a range from 0.3 mg to 20.0 mg of substance on the target. (auth)

24337 USE OF RADIOACTIVE KRYPTONATE OF SILICA GEL IN CHEMICAL ANALYSIS. II. Effect of Temperature on the Determination of Moisture in Gases. Naoum, M. M.; Jasenak, V.; Toelgyessy, J. (Slovak Technical Univ., Bratislava). Radiochem. Radioanal. Lett.; 14: No. 5-6, 373-378(5 Sep 1973).

In continuation to the determination of moisture reported in Part I, the effect of temperature was studied in the 25 to 32°C temperature range. It was found that the differential decrease of activity with concentration at constant temperature $(dA/dC)_t$ had a linear relation with temperature. (auth)

24338 QUADRIVALENT ACTINIDE TETRAKIS(HEXAFLUOROACETONYLPYRAZOLIDE) COMPOUNDS. Andruchow, W. Jr.; Karraker, D. G. (Univ. of Nijmegen, Netherlands). Contract AT(07-2)-1. Inorg. Chem.; 12: No. 9, 2194-2196(Sep 1973).

The synthesis and study of tetrakis(hexafluoroacetonylpyrazolide) compounds of U^{4+}, Np^{4+}, and Pu^{4+} and the tetrakis(hexafluoroacetonyl-3-methylpyrazolide), $(hfa\text{-}3\text{-}MePz)_4$, compounds of Th^{4+}, U^{4+}, Np^{4+}, and Pu^{4+} are reported. The preparation, characterization, and physical properties of these compounds are described. (DHM)

24339 PREPARATION AND LATTICE PARAMETERS OF CfF_4. Haire, R. B.; Asprey, L. B. (Los Alamos Scientific Lab., NM). Inorg. Nucl. Chem. Lett.; 9: No. 8, 869-874(Aug 1973).

Tetrafluorides of the actinides were known for the series Th to Bk, and the described preparation of CfF_4 extends the series and confirms the existence of the tetravalent state for Cf. Since these tetrafluorides have a monoclinic structure, good diffraction patterns and information on the atomic positions in the crystal are necessary in order to calculate the best lattice parameters from the powder data. Californium-249 was used in the studies, and the purified product contained <0.2 atom % of lanthanides and was >99.8 atom % pure with regard to total cation content. The CfF_4 was prepared by fluorination of $CfCl_3 \cdot XH_2O$, CfF_3, or Cf_2O_3 using 3 atm. of F_2 at 400 to 450°C for a period of two to three days. The resulting products were loaded into x-ray capillaries in an Ar atmosphere glove box to avoid exposure to air or moisture, and diffraction films were obtained from conventional Debye-Scherror cameras. Details of the data analysis are given. The product had a green color, and was isostructural with the tetrafluorides of Th to Bk; space group C2/c. The average room temperature lattice parameters were $\underline{a} = 12.425 \pm 0.004$ Å, $\underline{b} = 10.468 \pm 0.004$ Å, $\underline{c} = 8.126 \pm 0.003$ Å, $\beta = 126.02 \pm 0.02°$. Of the known actinide tetrafluorides Cf is the most difficult to oxidise to the tetravalent state. (UK)

24340 COMPLEXES OF URANYL ION WITH AMINO AND MERCAPTO ACIDS. Raghaven, A.; Santappa, M. (Univ. of Madras). J. Inorg Nucl. Chem.; 35: No. 9, 3363-3365(Sep 1973).

Cefola et al. (J. Phys. Chem.; 66: 790 (1962)) reported stability constants for complexes of uranyl ion with analogous ligands containing sulfur, nitrogen, and oxygen as donor atoms and found the order of the relative donor capacities to be N > O > S. Stability constants of systems of uranyl ion with various amino and mercapto acids are now presented. The objects are to determine the relative donor capacities of N, O, and S and to provide such data as might be of use from the point of the biological significance attached to such a study. (UK)

24341 COMPLEXES OF URANIUM(IV). 2. Adducts of Dichlorobis(acetylacetonato)uranium. Doretti, L.; Zanella, P.; Faleschini, S.; Faraglia, G. (Consiglio Nazionale delle Ricerche, Padua). J. Inorg. Nucl. Chem.; 35: No. 9, 3171-3175(Sep 1973).

The new complexes of uranium(IV), having formulae $(acac)_2 UCl_2 \cdot 2L$, (L = THF (tetrahydrofuran), ph_3 PO) and $(acac)_2 HCl_2 \cdot L'$ [L' = DME (dimethoxyethane), bipy (2,2'-bipyridine), phen (1,10-phenanthroline)], were isolated and characterized by ir and visible spectra. The results are consistent with the presence of chelated acetylacetonato groups and coordinated neutral ligands. (auth)

24342 STRUCTURE OF FLUORIDES. 1. Deviations from Ideal Symmetry in the Structure of Crystalline UF_6: A Neutron Diffraction Analysis. Taylor, J. C.; Wilson, P. W.; Kelly, J. W. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Acta Crystallogr., Sect. B; 29: No. 1, 7-12 (15 Jan 1973).

A neutron-diffraction powder pattern of crystalline UF_6 at 21°C has confirmed the x-ray structure of Hoard and Stroupe (USAEC Report TID-5290(1958) Paper 45). From the x-ray data it was not certain whether the fluorine atoms deviated significantly from ideal hexagonal close packing and the UF_6 octahedra from regularity. The neutron powder pattern of UF_6 was analyzed by the profile-fitting method of Rietveld (Acta Cryst. (1967), 22, 151). Significant deviations from the ideal parameters of Hoard & Stroupe were found. These effects are apparently caused by strong U–U repulsions in the unsymmetrical U(vl) arrangement and the U–F bonding in the octahedra. (auth)

24343 URANYL SULFATE SPECIES SORBED ON ION EXCHANGERS. Heitner-Wirguin, C.; Gantz, M. (Hebrew Univ., Jerusalem). J. Inorg. Nucl. Chem.; 35: No. 9, 3341-3347(Sep 1973).

Uranyl ions were sorbed on a cation and an anion exchanger from sulfate solutions. The visible and ir spectra of the species sorbed were recorded. An assignment of the spectra of the various sorbed species was made by comparing these spectra to those of species present in aqueous and non-aqueous phases. The species identified were $UO_2HSO_4^+$, $UO_2(SO_4)_2^{2-}$, and $UO_2(SO_4)_3^{4-}$. From ir data the R_{U-O} was evaluated and found to increase from 1.719 to 1.74 Å on increasing the number of coordinated sulfate groups. (auth)

24344 NITRIDE FLUORIDES OF URANIUM. Jung, W.; Juza, R. (Univ., Kiel). Z. Anorg. Allg. Chem.; 399: No. 2, 148-162 (Jul 1973). (In German).

Uranium nitride fluorides with compositions between UNF and $UN_{0.98}F_{1.20}$ were prepared by heating uranium nitride with uranium tetrafluoride. The oxidation state of uranium in these compounds is varying between 4 and 4.14. In the whole area there exists a tetragonal high-temperature phase and an orthorhombic low-temperature phase. The temperature of the transformation between these two phases depends upon the composition of the nitride fluoride. Structure investigations based on single crystals of the tetragonal phase showed that there is some similarity to the tetragonal lanthanium oxide fluoride. (auth)

24345 STUDY ON THE INTERACTION OF DIOXOURANIUM(VI) CHLORIDE AND NITRATE WITH UNPROTONATED THIAMINE. Marzotto, A. (Nazionale delle Ricerche, Padua). Inorg. Nucl. Chem.; 35: No. 9, 3403-3410(Sep 1973).

The reaction product of dioxouranium(VI) chloride and nitrate with unprotonated thiamine was studied. The compounds were characterized by elemental analysis and by electronic, ir, Raman, and ^1H NMR spectra. The coordination at uranium atom is discussed on the grounds of physico-chemical data. (auth)

24346 NEW COMBINATIONS IN UF_4–RARE EARTH FLUORIDE SYSTEMS. Denes, G.; Fonteneau, G.; Lucas, J. (Univ., Rennes, France). Compt. Rend., Ser. C; 276: No. 20, 1553-1556(14 May 1973). (In French).

The LnF_3-UF_4 system was studied at 1000°C. New compounds were observed for Ln = Lu, Yb, Tm, Er, Dy, Ho, and Y. The $LnUF_7$ composition was attained only for Ln = Lu, Yb, Tm, and Y. In contrast, a large homogeneity domain of the $Ln_{1-x}U_xF_{3+x}$ form exists in UF_4 rich regions for all the seven rare earths. These phases crystallize in the monoclinic system and are metastable beneath 900°C. (FR)

24347 SYNTHESIS OF ^{14}C-LABELLED AND UNLABELLED PCB COMPOUNDS. Sundstroem, G.; Wachtmeister, C. A. (Univ. of Stockholm). pp 73-86 of PCB Conference 2. Ahnland, E. (ed.). Stockholm; Allmaenna Foerlaget (1973).

From PCB conference 2; Stockholm, Sweden (14 Dec 1972).

Synthesis of ^{14}C-labelled isomers of tetra-, hexa- and octachlorobiphenyls of known structures are described. In order to obtain knowledge of the capabilities and limitations of the synthetic methods, some unlabelled polychlorinated biphenyls were synthesized before the labelling. The reactions studied were arylation of polychlorobenzene by treatment with a chlorinated aniline derivative in presence of nitrite, and synthesis of polychlorinated biphenyls via arylthallium compounds. Suitable starting materials for the synthesis of ^{14}C-labelled biphenyls with regard to availability are discussed. A mixture of labelled 2,2', 3', 4-tetrachlorobiphenyl (III) and 2,3', 4, 4'-tetrachlorobiphenyl (IV) was prepared through careful chlorination of acetanilide-^{14}C, acid hydrolysis of the received 2,4 dichloroacetanilide ^{14}C followed by a coupling with 1,2-dichlorbenzene. A mixture of two hexachlorobiphenyls was prepared in a similar way. The pure labelled isomers were not isolated. An appendix gives a survey of synthesis of different biphenyls. (KK) (Sweden)

24348 RADIONUCLIDE GENERATORS AND LABELLING KITS FOR USE IN NUCLEAR MEDICINE. Strecker, H. (Farbwerke Hoechst AG, Frankfurt am Main). Therapiewoche; 23: No. 18, 1606-1612(1973). (In German).

A brief outline of the importance of radionuclide generators for use in nuclear medicine is given. Pre-fabricated sets of equipment and measured quantities of substances, so-called labelling kits, permit the generator eluate to be processed in order to get suitable compounds. Hence the range of application is considerably extended. The generator-produced nuclides are shown in a number of tables, together with their characteristic data and their practical use, as well as a series of ^{99m}Tc and ^{113m}In-labelled compounds, including their specific application in nuclear medicine. (GE)

24349 TRACER DIFFUSION COEFFICIENTS IN AQUEOUS SOLUTIONS. I. The Method. Sodium and Sodium Chloride. Thomas, H. C.; Ku, J. C. (Univ. of North Carolina, Chapel Hill). J. Phys. Chem.; 77: No. 18, 2233-2235(30 Aug 1973).

A variant of a method for measuring tracer diffusion coefficients in gels which is applicable to aqueous solutions of ions with hard γ emitting isotopes is described. The coefficient for sodium chloride solutions in the range 0 to 0.5 M at 25° is given by $D \times 10^5 = 1.330 - 0.1568C^{\frac{1}{2}} + 0.1252C$. (auth)

24350 MECHANISM OF THE REACTION OF HYDROGEN WITH URANIUM. Hashino, T.; Okajima, Y. (Kyoto Univ.). J. Phys. Chem.; 77: No. 18, 2236-2241(30 Aug 1973).

The reaction mechanism of the formation and decomposition of uranium hydride was developed in terms of an absolute rate question. The equation derived is sufficient to describe characteristic features of the system, the explanation of which is beyond the scope of the classical approach based on the macroscopic treatment of chemical kinetics. The treatment proposed was justified by the fact that the equilibrium condition is of the same form as Lacher's isotherm, which is the most reliable equilibrium equation for transition metal–hydrogen systems, including the uranium–hydrogen system. The kinetic parameters of the simplified equation were determined from the experimental results, and the validity condition was tested. (auth)

24351 NOVEL CARRIER PREPARATION FOR INJECTABLE RADIOACTIVE COMPOSITIONS. Deutsch, M. E. (to CIS Radiopharmaceuticals, Inc.). U. S. Patent 3,743,714. 3 Jul 1973. Filed date 4 Dec 1970. 8p.

There is provided a novel method of producing injectable carrier compositions for radioactive compositions that are characterized by high stability and long shelf life. In particular these compositions are directed to those requiring the absorption of the appropriate radiotracer onto a colloidal substance such as colloidal sulfur and colloidal ferric hydroxide. There are also provided means for maintaining said compositions in stable form. (auth)

24352 PRODUCTION OF HIGH PURITY IODINE-131 RADIOISOTOPE. Arino, H.; Gemmill, W. J. Sr.; Kramer, H. H. (to Union Carbide Corp.). U. S. Patent 3,745,067. 10 Jul 1973. Filed date 9 Jan 1970. 6p.

High-purity radioactive ^{131}I is obtained in a stable chemical form by the dry distillation of a neutron-irradiated tellurium containing material, such as tellurium dioxide, onto alumina followed by elution with a base such as a dilute alkaline solution. Radioactive ^{131}I can be prepared by this process with a minimum of radioactive contamination to the immediate environment. The radioactive ^{131}I obtained by this process is a versatile tracer and is useful to determine blood volume, cardiac output, etc. (auth)

24353 PRODUCTION OF UF_4 BY ELECTROLYTIC REDUCTION. II. Pilot Plant. Esteban Duque, A.; Gispert Benach, M.; Hernandez Arroyo, F.; Montes Ponce de Leon, M.; Rojas de Diego, J. L. (Junta de Energia Nuclear, Madrid). Energ. Nucl. (Madrid); 17: No. 82, 113-121(1973). (In Spanish).

A continuously operating pilot plant for the production of UF_4 by electrolytic reduction was developed in order to realize long-duration experiments with the type of laboratory-scale cell described previously, to study on a larger scale the variables occurring, to learn the functioning connected with the different operations, and to obtain data that can be extrapolated to an industrial scale. This pilot plant is described. The operational data obtained, the difficulties encountered, and the real capacity of each step are reported. (tr-auth)

24354 SYNTHESIS AND CHARACTERIZATION OF TETRACHLOROBIS(CHLOROCYANO)NEPTUNIUM(IV), $NpCl_4 \cdot 2NCCl$. MacCordick, J.; Adloff, J. P. (Univ. Louis Pasteur, Strasbourg). Radiochem. Radioanal. Lett.; 14: No. 5-6, 341-347(5 Sep 1973). (In French).

A novel addition compound, $NpCl_4-2NCCl$, was prepared by the action of excess liquid cyanogen chloride on anhydrous $NpCl_4$. The vibrational spectra of the product suggest a polynuclear structure and show that the nitrile ligands are coordinated by a metal-nitrogen bond. The Np(IV) oxidation state in the complex is confirmed by the electronic spectrum. The existence of a second adduct, $NpCl_4-NCCl$, is indicated by thermal degradation measurements of the 1:2 compound at 120°C in a nitrogen atmosphere. An improved method for the synthesis of $NpCl_4$ is described. (auth)

24355 KINETICS OF THORIUM HYDRIDE THERMAL DISSOCIATION. Os'kina, T. E.; Zaborenko, K. B. Vestn. Mosk. Univ., Ser. II. Khim.; 14: No. 2, 172-176(1973). (In Russian).

Kinetic parameters were calculated by measuring the hydrogen evolution rate detected by chromatography under isothermal and polythermal conditions. There was a good agreement between the values calculated for isothermal and polythermal conditions. (auth)

24356 NITRIDE FLUORIDES OF ZIRCONIUM AND URANIUM. Summary. Jung, W. Kiel; Univ. Kiel (1972). 17p. (In German). Thesis.

Preparation, properties, and structures of the nitride fluorides of zirconium and uranium are reviewed. (GE)

24357 RADIOACTIVE SILVER IN EAST EUROPEAN SILVER BARS. Boyle, R. W. (Geological Survey of Canada, Ottawa). Nature (London); 243: No. 5408, 460-461(22 Jun 1973).

It is stated that the discovery of slightly radioactive Ag in the form of ^{108m}Ag and ^{110m}Ag in East European Ag bars is of interest since so far as is known these short lived isotopes have not hitherto been observed in natural materials. Various explanations have been given for the presence of the radioactivity, one of which is that the Ag ore was mined by the use of an underground nuclear explosion. An alternative natural explanation, however, seems more probable. Some of the Ag deposits in Eastern Europe contain U, mainly as pitchblende, and most of these are veins not particularly amenable to nuclear mining. The production of the ^{108m}Ag and ^{110m}Ag isotopes is essentially due to slow neutron bombardment, the neutron capture reaction involving ^{109}Ag and ^{110}Ag being $^{109}Ag(n,\gamma)^{110m}Ag$. In uraniferous Ag deposits there are several neutron sources, including (α,n) reactions, and the spontaneous fission of U. The number of neutrons spontaneously emitted from natural U has been calculated as about 1.5×10^{-2}/g/s; although this is a low neutron density it is probably sufficient to produce low levels of ^{108m}Ag and ^{110m}Ag in Ag ores, and this could become concentrated in production of the Ag bars to measurable amounts. (UK)

24358 DISCOVERY AND NAMING OF THE ISOTOPES OF ELEMENT 91. Fajans, K.; Morris, D. F. C. (Univ. of Michigan, Ann Arbor). Nature (London); 244: No. 5412, 137-138(20 Jul 1973).

The history of the discovery and naming of the three naturally occurring isotopes of element 91 are outlined in order to eliminate contradictions to be found in the literature. Information about the nineteen isotopes of protactinium now known is listed. (auth)

24359 STRUCTURAL SYSTEMATICS IN ACTINIDE FLUORIDE COMPLEXES. Penneman, R. A. (Los Alamos Scientific Lab., NM); Ryan, R. R.; Rosenzweig, A. pp 1-52 of Structure and Bonding. Volume 13. Dunitz, J. D. (ed.). Heidelberg; Springer-Verlag (1973). (LA-DC-12833).

The structural characteristics displayed by actinide fluoride complexes are reviewed. Topics considered include: trends in actinide size and valence; coordination number and polyhedra; depolymerization by fluoride; variable valence in fluoride compounds; structural characteristics of six-coordinated actinide fluoride complexes, seven-coordinated actinide fluoride complexes, eight-coordinated actinide fluoride complexes, and nine-coordinated actinide fluoride complexes; and optical characteristics. (174 references) (DHM)

24360 BIOCHEMISTRY AND METHODOLOGY OF LIPIDS. Johnson, A. R.; Davenport, J. B. (eds.). New York; John Wiley and Sons, Inc. (1971). 578p.

Twenty-five papers on biochemistry and methodology of lipids are presented. A separate abstract was prepared for the paper that was in scope for NSA. (DHM)

For an abstract of an individual paper see: 24361.

24361 RADIOCHEMICAL TECHNIQUES. Johnson, A. R. (CSIRO, Sydney). pp 307-335 of Biochemistry and Methodology of Lipids. Johnson, A. R. (ed.). New York; John Wiley and Sons, Inc. (1971).

Methodology and application of radiochemical techniques in lipid chemistry are outlined. Characteristics and preparation of radioisotopes used, and the preparation and purity of radiochemicals incorporating some of these radioisotopes are described. Methods, equipment, and sample preparation in liquid scintillation counting and radiochromatography are reviewed. 78 refs. (AT)

24362 CHEMICAL, NUCLEAR, AND BIOLOGICAL PROPERTIES OF THE TRANSURANIUM ELEMENTS. Keller, C. (Univ., Karlsruhe, Ger.). Naturwiss. Rundsch.; 26: No. 5, 191-204(1973). (In German).

A survey is given on the peculiarities in the behavior of the transuranic elements compared to other element groups of the periodic system. These are very strongly determined by exterior non-element specific influences, such as radioactive decay and release of heat and radiation. The resulting problems and the fact that the study of numerous elements can only be carried out on a micro scale or with individual short-lived atoms have lead to new experimental techniques that primarily depend on the availability of the individual elements. The chemistry and biology as well as the nuclear properties of the transuranic elements are discussed in detail. (GE)

Radioactive Waste Treatment

24363 (AEC-tr-7464) DETRITIATION OF HEAVY WATER FROM NUCLEAR REACTORS. Leger, D.; Dirian, G.; Roth, E. Translated from Energ. Nucl. (Paris); 12: 135-142(1970). 20p. Dep. NTIS $3.00.

Three methods are considered for the removal of tritium from heavy water: distillation of heavy water, catalytic exchange, and electrolysis. A combination of the isotopic exchange and distillation procedures was found to be suitable for the detritiation of heavy water. Criteria for the exchange reactors and distillation columns are given. (JGB)

24364 (BMFT-FBK-73-13) STUDIES ON THE DECONTAMINATION OF RADIOACTIVE WATER BY PRECIPITATION OF SOAPS. Deuber, H.; von Erichsen, L. (Bonn Univ. (West Germany). Institut fuer Physikalische Chemie). Jun 1973. 145p. (In German). Dep. NTIS (U. S. Sales Only) $9.25.

The influence of various factors on the removal of radioactive ions from water by precipitation of soaps was examined, especially the influence of the anion and cation of the soaps. The best results are achieved with the soap anion C12 and the soap cations Ca and Mg. In one stage, using C12 and Ca or Mg, one may expect an optimal removal of 90 to 99.99% in the case of trivalent cations and of 90 to 99% in the case of divalent cations. Monovalent cations and anions are not removed. (auth)

24365 (IAEA-R-525-F) USE OF BITUMENS AND ASPHALTS FOR DECONTAMINATION PURPOSES. Final Report, 1 October 1967–30 June 1970. Farah, M. Y.; Misak, N. Z.; Azer, M. M. (International Atomic Energy Agency, Vienna (Austria)). Jun 1971. 65p. INIS.

A study is reported that is concerned with determining the applicability of two types of Egyptian bitumen, namely Mexphalt 80/100 and Mexphalt 40/50, to the incorporation of inactive or low activity salt mixtures (simulated evaporator waste solutions contaminated with about 10^{-4} curies per liter of ^{134}Cs) and inorganic ion exchange media containing 10^{-4} to 10^{-3} curie ^{134}Cs per kilogram. Bituminization of other simulated wastes containing ^{89}Sr and $^{95}Zr-^{95}Nb$ was investigated. Hardness and softening points of the product increased with the incorporation of nitrates and other solids. In general, elevation of softening points was accompanied by a subsequent decrease in penetration by nearly half for nitrates and evaporator wastes and to even lower values with vermiculite. Ductility was also reduced and flash points were significantly raised. The leaching rates of ^{134}Cs and ^{89}Sr from bitumen incorporating simulated evaporator waste compare favourably with those in the literature. The leach rate for ^{89}Sr is smaller than for ^{134}Cs. Immersion in NaOH leads to lower leach rates than in sea water. Leach rates of ^{134}Cs, ^{89}Sr and $^{95}Zr/^{95}Nb$ from bitumen containing clays, sands and vermiculites were extremely low and in some instances seem to be zero. (INIS)

24366 (IAEA-R-874-F) VITRIFICATION OF COMPATIBLE INTERMEDIATE AND HIGH LEVEL LIQUID RADIOACTIVE WASTES. Final Report, 1 February 1970–31 January 1971. Thomas, K. T. (International Atomic Energy Agency, Vienna (Austria)). Jun 1971. 49p. INIS.

A study is reported of various glass matrices and their compatibility with high level radioactive wastes generated by the processing of irradiated fuels from the Indian reactors at CIRUS, RAPP, and TAPP sites and their applicability to the safe and economic solidification of these wastes. The glass forming systems studied were silicate systems containing Na_2O, FeO, MnO, PbO, B_2O_3, and SiO_2, and phosphate systems containing Fe_2O_3, SiO_2, Al_2O_3, MnO, PbO, Na_2O, and P_2O_5. Glasses of the type Na_2O, MnO, $FeO-SiO_2$ were suitable for incorporating up to 20% by weight of waste oxides and had leach rates in the order of 10^{-5} cm per day. Melting points were in the range of 1050 to 1100°C. Glasses in the system Na_2O, FeO, PbO, $B_2O_3-SiO_2$ were pourable between 800 and 950°C and had leach rates in the range 8×10^{-6} to 1×10^{-6}gm per cm^2 per day. Melting temperatures of the phosphate glasses increased with increasing Fe_2O_3 content and decreased with increasing P_2O_5 content. Leach rates were in the order of 10^{-4} to 10^{-6}gm per cm^2 per day. Waste oxides could be incorporated to the extent of 20 to 40% in the various systems and volume reductions of waste were in the order of 20 to 36. Activity incorporated per kg of glass ranged from 800 to 6000 Ci. Solubility of ruthenium in phosphate glasses was generally found to be higher than in silicate glasses. Work is continuing on phase compositions, phase relations, fusion temperatures, corrosion characteristics, suppression of ruthenium volatility and physical properties of the melts. (INIS)

24367 (ICP-1021) FIFTH PROCESSING CAMPAIGN IN THE WASTE CALCINING FACILITY, FY-1972. Wielang, J. A.; Freeby, W. A. (Allied Chemical Corp., Idaho Falls, Idaho. Idaho Chemical Programs Operations Office). Jun 1973. Contract AT(10-1)-1375. 35p. Dep. NTIS $4.00.

The Fifth Processing Campaign, from September 23, 1971 to May 11, 1972, was devoted to the processing of zirconium–fluoride, aluminum nitrate, and stainless steel–sulfate wastes. The chronology of the campaign, process evaluation, and equipment performance are discussed. (auth)

24368 (ICP-1025) CHEMICAL DEVELOPMENT WORK IN SUPPORT OF FLUIDIZED-BED CALCINATION OF RADIOACTIVE WASTES AT THE IDAHO CHEMICAL PROCESSING PLANT. Rhodes, D. W. (Allied Chemical Corp., Idaho Falls, Idaho. Idaho Chemical Programs Operations Office). Aug 1973. Contract AT(10-1)-1375. 23p. Dep. NTIS $4.00.

Aqueous radioactive wastes at the Idaho Chemical Processing Plant are routinely converted to granular solids by calcining in a fluidized-bed calciner at 400 to 500°C. Wastes calcined to date include acid aluminum nitrate, acid zirconium fluoride, acid-deficient ammonium nitrate, and acid stainless steel sulfate. Significant chemistry development work performed to make possible the calcination of these wastes was associated with, (1) formation of alpha instead of amorphous alumina, (2) volatilization of fluoride, sulfate, and ruthenium, (3) incomplete decomposition of ammonium nitrate, (4) potential volatilization of mercury, and (5) formation of a potentially hazardous solid in the scrubbing

solution. Methods used to solve problems in these areas are discussed. (auth)

24369 (ORNL-TM-4125) ENGINEERING EVALUATION OF THE IODEX PROCESS: REMOVAL OF IODINE FROM AIR USING A NITRIC ACID SCRUB IN A PACKED COLUMN. Groenier, W. S. (Oak Ridge National Lab., Tenn.). Aug 1973. 67p. AT.

The simple countercurrent contact of nitric acid with air containing iodine or methyl iodide in packed columns was studied under various processing conditions to develop a basic understanding of the Iodex process. The classical two-film theory of mass transfer was applied in an attempt to translate experimental mass-transfer data to meaningful engineering design parameters such as mass-transfer coefficients. Actual decontamination factors for elemental iodine were as high as 3.5×10^4 in a 56-cm-long tower, or 300 per foot of packing, and were shown to be a function of acid concentration, temperature, and gas residence time. Efficient removal was obtained with 70% HNO_3 at temperatures above 80°C or with 80% HNO_3 at temperatures of 30°C or above. Methyl iodide was most effectively destroyed at high acid concentrations. Iodine decontamination factors were as high as 6.6×10^5 in a 117-cm-long tower, or 33 per foot of packing. Efficient removal was obtained with boiling 70% HNO_3 or with 80% HNO_3 at temperatures of 60°C and above. The effects of chemical rate and mass distribution constants on the transfer unit height are shown for two typical runs. Absolute values of the mass-transfer coefficient can be obtained when more accurate estimates for the chemical rate and mass distribution constants are available. (auth)

24370 OXIDANT FOR TRAPPING ATMOSPHERIC RADIOKRYPTON. Liebman, J. F. (Univ. of Maryland, Baltimore). Nature (London); 244: No. 5411, 84-85(13 Jul 1973).

Mechanisms for the removal of radioactive Xe and Kr from the effluent gases of nuclear power plants and fuel processing plants are discussed. It had previously been found that $O_2^+SbF_6^-$ successfully trapped Xe, but not Kr. $N_2F^+SbF_6^-$ appears to be a simple reagent for removing both gases. It is suggested that $O_2^+SbF_6^-$ and $N_2F^+SbF_6^-$ be used sequentially to remove Xe and Kr, followed by treatment with a reducing agent, such as Fe filings, to remove any F_2 formed. (UK)

Radioisotope Production

Refer also to abstract 24868.

24371 (FMI-1000-450) RAPID INCORPORATION OF SHORT LIVED CYCLOTRON-PRODUCED RADIONUCLIDES INTO RADIOPHARMACEUTICALS. Lathrop, K. A.; Harper, P. V.; Rich, B. H.; Dinwoodie, R.; Krizek, H.; Lembares, N.; Gloria, I. 1972. 16p. (CONF-730309-11). Dep. NTIS $3.00.

From symposium on new developments in radiopharmaceuticals and labelled compounds; Copenhagen, Denmark (26 Mar 1973).

Production methods for two sterile, pyrogen-free preparations of 10-min ^{13}N were developed, and used clinically. Nitrogen-13 is produced by the $^{12}C(d,n)^{13}N$ reaction on methane or by the $^{16}O(p,\alpha)$-^{13}N reaction on gaseous oxygen or on water. It is converted to $^{13}NH_4^+$ and used directly for myocardial localization, or is utilized as a substrate for the enzymatic synthesis of L-glutamate which shows some promise for visualization of the pancreas. A sterile pyrogen-free solution of ^{13}N-glutamate may be produced by enzymatic reaction of $^{13}NH_4^+$ in Tris-buffer at pH 8 with NADPH and α-ketoglutarate. Acetate labeled in the carboxyl position may be prepared by the Grignard reaction with $^{11}CO_2$, which is produced by the $^{13}N(p,\alpha)^{11}C$ reaction on gaseous nitrogen containing a trace of oxygen. (DHM)

24372 (ORNL-4884) TRANSURANIUM PROCESSING PLANT SEMIANNUAL REPORT OF PRODUCTION, STATUS, AND PLANS FOR PERIOD ENDING DECEMBER 31, 1972. King, L. J.; Bigelow, J. E.; Collins, E. D. (Oak Ridge National Lab., Tenn.). Aug 1973. Contract W-7405-eng-26. 28p. Dep. NTIS $4.00.

During the period July 1, 1972, through December 31, 1972, transuranium elements were recovered from three SRP Pu–Al tubes that had been irradiated at the Savannah River Plant (SRP) as a part of the Californium-I program to evaluate the commercial market for ^{252}Cf and to establish an inventory of material for sale. During the next 18 months, a total of 875 mg of ^{252}Cf is expected to be recovered: 300 mg from 24 TRU-HFIR targets, 500 mg from 30 SRP Cm-HFIR targets, and 75 mg from 3 SRP reactor tubes. Totals of 73 mg of ^{249}Bk and 4.0 mg of ^{253}Es are expected to be recovered from these targets and tubes. Also, 1.8 of ^{244}Pu, 50 mg of ^{248}Cm, and 1.8 μg of ^{254}Es are expected to be obtained from previously processed materials and from some materials for which processing is planned. Laboratory studies were made during this period to increase the knowledge of the behavior of impurities in the high-pressure ion exchange process during purification and encapsulation of californium products. Three neutron sources were fabricated, bringing the total fabricated to 60. In special projects, three ^{253}Es rabbits and one ^{257}Fm rabbit were encapsulated, irradiated, and shipped to ANL. (auth)

24373 PREPARATION OF HIGHLY PURIFIED ^{228}Ac TRACER SOLUTIONS. Monsecour, M.; De Regge, P.; Demildt, A. (Studiecentrum voor Kernenergie, Mol, Belg.). Radiochem. Radioanal. Lett.; 14: No. 5-6, 365-371(5 Sep 1973).

Actinium-228 tracer with a radiochemical purity of 99.8% was prepared from a $^{226+228}Ra$ equilibrium mixture by a fast separation technique using titanium phosphate ion exchanger. (auth)

24374 STABLE SOLUTIONS CONTAINING MOLYBDENUM-99 AND PROCESS OF PREPARING SAME. Lewis, R. E.; Tenorio, J. I. (to General Electric Co.). U. S. Patent 3,752,769. 14 Aug 1973. Filed date 4 Mar 1971. 6p.

A method of preparing a stable solution containing ^{99}Mo is presented in which the starting material of molybdenum trioxide containing the ^{99}Mo is dissolved in a sufficient amount of aqueous ammonium hydroxide to give an ammonium molybdate solution having a pH in the range of about 7.5 to about 9.5. The solution is then filtered to remove any suspended solids, and from about 0.12 to about 0.60 wt % of sodium hypochlorite in the form of an aqueous solution is added to the ammonium molybdate solution. This process gives a stable ammonium molybdate solution with a pH in the range of about 7.5 to about 9.5 comprising from about 0.12 to about 0.60 wt % sodium hypochlorite, up to about 0.46 of ammonium molybdate per milliliter of solution and the balance water. The stable ammonium molybdate solution remains water-clear and free of discoloration from radiolytic reduction of molybdenum for the usual life of the solution. (auth)

24375 EXTRACTION OF TRANSPLUTONIUM ELEMENTS FROM AN AQUEOUS SOLUTION CONTAINING RARE EARTHS AND FISSION PRODUCTS. Koehly, G. (to Commissariat a l'Energie Atomique). U. S. Patent 3,748,104. 24 Jul 1973. Priority date 29 Mar 1968, France. 4p.

A method is reported for treatment of aqueous solutions containing transplutonium elements, rare earths, and fission products. More precisely it is a method for removal of fission products from these solutions, characterized in that the acid concentration of the solutions is adjusted to a normality that is higher than 1 N and that the solutions are contacted with an organic phase consisting of an organophosphorus acid diluted in a solvent that is immiscible with water. The fission products are extracted by the organic phase. (auth)

24376 EXTRACTION AND PURIFICATION OF IONIUM BY SORPTION FROM SOLUTIONS AND PULPS OF VARIOUS COMPOSITIONS. Vodolazov, L. I.; Laskorin, B. N.; Stepanova, L. M.; Surovyagin, B. P.; Shatalov, V. V. J. Appl. Chem. USSR (Engl. Transl.); 46: No. 3, 574-578(Mar 1973).

Translated from Zh. Prikl. Khim.; 46: No. 3, 548-552(Mar 1973).

Sulfuric acid was used for the leaching of ionium (^{230}Th) from silicate–carbonate, aluminosilicate, and iron carbonate rocks. SG 1 × 5 cation exchange resin was used for sorption of ionium from the H_2SO_4 solutions and pulps in the 2.5 to 3.5 range, the sorption capacity being higher at the lower pH. Elution of ionium by mineral acids was found to decrease in the series 2N HNO_3 > 2N HCl > 2N H_2SO_4. Sorption from the eluants was effected by the cation exchangers KU-2, KU-22, and KU-2p in H form, and by the aminophosphate ion exchanger AFI-5, after treatment with ammonium hydroxide. It was found that the best extraction agents for ionium are trioctylphosphine oxide (TOPO) and a mixture of TBP and bis(2-ethylhexyl)phosphoric acid (DEHPA). The effects of other thorium isotopes and other elemental impurities on the purification of ionium are considered. (JGB)

Reactor Fuel Reprocessing

Refer also to abstract 24151.

24377 (AEC-tr-7438) INVESTIGATIONS ON THE REPROCESSING OF GRAPHITE–CARBIDE FUEL FOR HIGH TEMPERATURE REACTORS. Bildstein, H.; Knotik, K. Translated by Rebecca Greer (New Brunswick Lab., NJ) from Kerntechnik; 8: No. 3, 110-115(1966). 14p. Dep. NTIS $4.00.

For operation of gas-cooled high-temperature reactors, fuel elements are used that consist of a graphite shape in which so-called coated particles are dispersed. Methods for the reprocessing of such graphite–carbide fuels were investigated. Electrolytic and bromination techniques for decomposition of the graphite

were investigated. For the decomposition of the coating on the layered particles, burning of the pyrocarbon layer, thermoshock treatment, and thermal chlorination were studied. Various combinations of these decomposition methods in the "head-end" stages were considered. The effect of the fuel composition on the selection of the head-end method was considered. (JSR)

24378 (ANL-7994) CHEMICAL ENGINEERING DIVISION FUEL CYCLE TECHNOLOGY FINAL REPORT. Webster, D. S.; Jonke, A. A.; Levitz, N. M.; Miller, W. E.; Steindler, M. J.; Vogel, R. C.; Burris, L. (Argonne National Lab., Ill.). Mar 1973. Contract W-31-109-eng-38. 44p. AT.

Progress is reported in the following areas for the period from October, 1972, to March, 1973: (1) a series of experiments to investigate the chemical reactions taking place in the reduction and composition-adjustment steps of the pyrochemical head-end process, a series of experiments to determine whether reduction of fuel oxide can be effected by fluid flow in the absence of an agitator, and another series of experiments to study the reactions of uranium and plutonium (dissolved in a metal alloy) with Ca_3N_2 and Mg_3N_2 (a proposed U–Pu isolation step); (2) fluid-bed denitration of mixed uranium and plutonium nitrate solutions having a Pu/U ratio of 1/4 and plutonium nitrate solution alone, and fluid-bed reduction of UO_3–PuO_2 to UO_2–PuO_2; (3) study of the feasibility of using a diffractometer having a non-dispersive (energy-dispersive detector) analyzer for measuring lattice parameters and thereby the oxygen-to-metal ratio of oxide fuels; and (4) study of the suitability of materials proposed for cathodes of electrolytic cells (for the reduction of plutonium in a Purex process application. (auth)

24379 (BARC-659) TRILAURYLAMINE (TLA) AS AN EXTRACTING AGENT FOR THE FINAL PURIFICATION OF PLUTONIUM DURING THE REPROCESSING OF IRRADIATED FUEL: A LITERATURE SURVEY. Nair, G. M.; Singh, N. P.; Sethuraman, P. R.; Khopkar, P. K. (Bhabha Atomic Research Centre, Bombay (India)). 1973. 42p. Dep. NTIS (U. S. Sales Only) $4.25.

The properties of trilaurylamine (TLA) were found to be suitable for its potential use as an extracting agent in the final purification of plutonium during the reprocessing of the irradiated uranium fuel. Extensive work was carried out on the solvent properties of this amine for various ions that are of importance in the reprocessing cycle. A literature survey made on some of the interesting aspects of TLA as a solvent, such as the extraction of Pu(IV) and U(VI), back extraction of plutonium from the organic phase, the kinetics of extraction and back-extraction and the degradation and recovery of the extractant in large scale operations are summarized. From the published data, TLA appears to be a worthy substitute for the anion exchange resin in the final purification of plutonium from uranium and fission products. (auth)

24380 (CEA-R-4469) MECHANICAL DECLADDING OF OXIDE FUELS CLAD WITH STAINLESS STEEL. Matcheret, G.; Bourgeois, M. (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). Aug 1973. 28p. (In French). Dep. NTIS (U. S. Sales Only) $3.50.

A mechanical decladding method applicable to LWR or LMFBR oxide fuels is described. First, the fuel pins are chopped. Then the obtained pieces are crushed or hammered in order to separate oxides as powder from the cladding material. Very good results were obtained for RAPSODIE fuel pins irradiated in the range 33,000 to 50,000 $MWdt^{-1}$. This method is not specific for the cladding material, the obtained powder can be fed continuously either in an aqueous or in a nonaqueous plant. (auth)

24381 (ORNL-TM-4301) AQUEOUS FUEL REPROCESSING QUARTERLY REPORT FOR PERIOD ENDING JUNE 30, 1973. Unger, W. E.; Blanco, R. E.; Crouse, D. J.; Irvine, A. R.; Watson, C. D. (Oak Ridge National Lab., Tenn.). Aug 1973. Contract W-7405-eng-26. 43p. AT.

The gas plenum section of a prototype subassembly was severed in a highly acceptable manner with a Linde PT-7 plasma-arc torch. Using a 4 × 12 torch tip (starting gas, 25% argon–75% nitrogen; cutting gas, 65% argon–35% hydrogen), a prototype subassembly rotated at 3 rpm under the stationary torch was severed successfully in 35 sec. A porcelain-filled subassembly compacted by an experimental rectangular 1- by 3-in.-wide (subtended by a 30° angle) gag compactor (ORNL 250-ton shear) by 50 tons of force reduced the void fraction from 0.45 to 0.15 and the 217 fuel rods appear to be securely restrained in the deformed shroud. Additional shapes are to be evaluated prior to selection of the final gag unit for the bundle shear. Additional dissolution studies with unirradiated PuO_2 microspheres and with both irradiated and unirradiated UO_2–PuO_2 showed that Ce^{4+} is much more effective than Ce^{3+} in promoting plutonium dissolution. Development of the Iodex and mercuric scrubbing processes for removal of iodine from off-gases was continued, although the Iodex process has been chosen as the prime candidate. The feasibility of producing hyper-azeotropic nitric acid for the Iodex process was explored in some experimental tests. Three series of Iodex experiments were performed in the 4-cm-diam by 117-cm-high packed column for the purpose of determining the effect which recycling the acid scrub solution had upon the removal of tagged methyl iodide from an air stream. The system performed equally well when operated in either the recycle acid mode or once-through acid mode. In the presence of hexane contaminant, similar overall performance was observed for either the recycle acid or once-through acid, but the measured overall DF was about a factor of 5 lower than for hexane-free air. Preparation of engineering flowsheets for a commercial-scale reprocessing plant has emphasized the additional cost that results from microinhomogeneity of LMFBR fuel. Microinhomogeneity causes partial preferential dissolubility in the fuel which necessitates use of a noxious dissolution catalyst, two centrifuges, and possibly three additional dissolvers. (auth)

24382 METHOD AND DEVICE FOR THE SEPARATION OF URANIUM AND PLUTONIUM COMPOUNDS BY MEANS OF SOLVENT–SOLVENT EXTRACTION. Baumgaertner, F.; Schwind, E.; Schlosser, P. (to Gesellschaft fuer Kernforschung mbH). German Patent 1,905,519. 1 Feb 1973. 8p. (In German).

A procedure for separating uranium and plutonium compounds by solvent–solvent extraction is described in which plutonium is converted to the trivalent state by means of electrolytic reduction in such a manner that it is reduced from the organic phase. The uranium is retained during the extraction process in a mixture of aqueous and organic phase and is thus separated together with the aqueous phase. The equipment used for this method is a mixer-settler, with the cathodes being in the mixer chambers, the surface of these cathodes being coated with gold, or with titanium as cathode material. The anodes are in diaphragms closed at one end and are placed in the settler chambers. They may be either tantalum, titanium, or niobium electrodes. (GE)

ENGINEERING

Energy Conversion

Refer also to abstracts 24596–24601, 26306, 26348, 26370, 26772, and 26789.

24383 (AD-757087) PERFORMANCE RELIABILITY CALCULATION FOR A MODULAR SOLAR THERMOELECTRIC GENERATOR. Malevskii, Yu. N. Translated from Geliotekh., Akad. Nauk Uzb. SSR; No. 1, 16-20(1971). 8p. NTIS.

An analysis is given of the overall reliability of a solar energy converter unit composed of thermoelectric modules, as a function of the reliability of individual photocells and component modules. Expressions are given to determine the reliability of various module circuit designs having the modules in series, parallel and combined connections. The usefulness of redundancy in these designs is noted. Suggestions are given concerning the selection of module circuit designs most suitable for given operational requirements. (auth) (NTIS)

24384 (AD-757414) MICE: AN IMPLICIT DIFFERENCE SCHEME FOR MHD CALCULATIONS. Fajen, F. E. (Mission Research Corp., Santa Barbara, Calif. (USA)). Mar 1973. Contract DASA01-71-C-0054. 38p. (MRC-R-12; MRC-IR-72-29; DNA-2877-Z). NTIS.

The MICE code, which uses new numerical technique for solving the one fluid MHD equations, is described. Although the technique evolved from some of the general ideas developed by Harlow and Amsden in their ICE (Implicit, Continuous-Fluid, Eulerian) method, it has been extensively modified, and is best described as an implicit Lax-Wendroff technique. The approximation of time-step-splitting is used, which greatly simplifies the numerical solution. Some numerical results are presented for two test problems. The MICE computation of the early expansion and rise of a hot bubble is an exponential atmosphere is compared to previously published calculations of the same problem. The buoyant rise of a warm infinitely long cylinder is calculated and the shape of the boundary is compared to an exact solution obtained by G. McCartor of MRC. The agreement is satisfactory in both cases. (auth) (NTIS)

24385 (ARCO-3057-13) RADIOISOTOPE POWERED CARDIAC PACEMAKER PROGRAM. Phase II. Mid-term Report, February 1, 1970–October 31, 1972. (ARCO Nuclear Co., Leechburg, PA). 1972. Contract AT(11-1)-3057. 291p. Dep. NTIS $7.60.

Research and development activities on the fabrication and testing of ^{238}Pu-powered cardiac pacemakers are summarized. (TFD)

24386 (JPRS-59983, pp 1-102) MOST IMPORTANT RESULTS OF SCIENTIFIC RESEARCH IN 1972. 7 Sep 1973. Translation of Vazhneyshie Rezul'taty Nauchnoissledovatel'skikh Rabot 1972 Goda, Izdatel'stvo Nauka, Moscow, 1973. In USSR High Temperature Institute.

The principal results of research conducted at the High Temperature Institute of the USSR Academy of Science during 1972 are reported. The subjects investigated included: the thermophysical and electrophysical properties of matter at high temperatures; high-temperature heat exchange, mass exchange, and physical gas dynamics processes; development of new refractory construction materials, and MHD energy converters and other new types of power generating equipment. (LCL)

24387 (JPRS-59983, pp 103-232) RESEARCH ON THE U-25 APPARATUS. Kirillin, V. A.; Kirillov, V. V.; Kirillov, V. G.; Momotov, Yu. M.; Mostinskii, T. L.; Nedospasov, A. V.; Pashkov, S. A.; Pinkhasnk, M. S.; Pishchikov, S. I.; Poberezhskii, L. P.; Rabkin, Yu. I.; Rekov, A. I.; Sidorov, V. S.; Telegin, G. P.; Sheyndlin, A. E.; Shelkov, E. M.; Shumyatskii, B. Ya. 7 Sep 1973. Translation of Issledovaniya na Ustanovke U-25 (I), Moscow, 1973. USSR High Temperature Institute.

The U-25 pilot apparatus with a magnetohydrodynamic power generator is described. The heat loop parameters of the apparatus are presented. The basic systems and units, including the flue, the steam power loop, cooling system, ionizing additive intake and discharge systems, inverter substation, measurement and control systems, combustion chamber, MHD generator and steam generator are described. The results of tests of various types of combustion chambers and steam generators are presented. The combustion chamber heat losses are evaluated. The diagnostic measurement system in the channel of the MHD generator is described. Data on the distribution of generated power through the channel, distribution of electrode potentials and insulation wall moduli, and time changes of MHD channel parameters during line-out are given. The methods of quasi-unidimensional (hydraulic) calculations of MHD flow, of calculations of two-dimensional electric fields in the MHD generator channel and of two-dimensional thermal fields are presented. Design-theoretical analysis of some of the experimental results is accomplished. (auth)

24388 (N-73-14746) EXPERIMENTAL INVESTIGATIONS OF AN OPEN-CYCLE, VORTEX MHD GENERATOR. Conroy, G. J.; Kurtzrock, R.; Snedden, R. B.; Demeter, J. J.; Bienstock, D.; Hughes, W. F. (Bureau of Mines, Pittsburgh, PA. Health and Safety Research Testing Center). 1972. 31p. (BM-RI-7699). NTIS.

Electrical power generation was studied in a laboratory scale, open-cycle vortex MHD generator, which offers several advantages over straight channel generators that require separate combustors. Compactness, lower capital cost, and high energy release are obtained by combining the combustor and generator into one unit in the vortex generator. In addition, the vortex generator uses a simple solenoid rather than the more complex and expensive saddle magnet required for straight channel generators. The primary motivation for this experimental device in terms of ultimate objective was to investigate the vortex generato. with applications to direct coal firing and with combustion taking place in specially designed expansion nozzles. The vortex device offers one decided advantage over the linear device in this regard because slag deposits do not degrade or short-circuit the coaxial electrodes as is the case for a linear machine. Power was obtained by impressing an axial field of 3,000 G from an air core solenoid magnet. Tests were conducted by seeding natural gas seeded with potassium acetate and burning with preheated oxygen enriched air. Power generation was lower than calculated because theoretical plasma velocities were not achieved. (auth)

24389 (SLA-73-613) RTG THERMOPILE GLASS BONDING PROCESS DESCRIPTION (1D-W). Matsko, J.; Philgreen, F. A.; Snidow, R. D.; Tuthill, C. D. (Sandia Labs., Albuquerque, N. Mex.). Aug 1973. 183p. Dep. NTIS $7.60.

A detailed description is provided of the current glass bonding and associated processes that have been developed at Sandia Laboratories for the fabrication of one-dimensional, high-resistivity tungsten interconnect thermopiles (1D-W). The necessary information for transferring HR technology to the selected production agency is given. Operator techniques, material and equipment, documentation procedures, and methods of process and quality control are described. Drawings of tools and fixturing are included. (auth)

24390 ENERGY FROM ELECTROGASDYNAMICS. Musgrove, P. J. (Univ. of Reading, Eng.). Electron. Power; 19: No. 14, 327-330(9 Aug 1973).

Electrogasdynamics (EGD), a technique for generating electrical power directly from a moving gas stream, is reviewed. An important characteristic of proposed EGD energy-conversion systems is the absence of any mechanical moving parts. Instead, use is made of the interaction between a stationary electric field and charged particles which are swept through the field by a moving gas stream. Single stage and multistage EGD expanders are shown schematically. Efficiency problems are discussed. In the existing ambient-pressure EGD generator at Reading an isentropic efficiency (the ratio of the useful power output to the sum of the useful power output and the power losses) of 53% is theoretically possible whereas the maximum efficiency so far achieved is 12%. Using a multistage EGD expander with reheat, the Ericsson cycle, one can expect to convert heat to electricity at an overall efficiency of about 42%. The range of applications of the EGD system is discussed with especial reference to the field of low temperature refrigeration. (UK)

24391 CHOICE OF THE PARAMETERS OF A PEAKING MAGNETOHYDRODYNAMIC UNIT. Ivanov, P. P.; Kovbasyuk, V. I.; Koryagina, G. M.; Rogachev, A. P. (High Temperature Institute, Academy of Sciences of the USSR). High Temp. 10: No. 5, 980-984 (May 1973).

For spanning the variable part of the graphs of the electrical load, the article proposes simplified units with magnetohydrodynamic generators (magnetohydrodynamic electric power plants). The oxidizer for the fuel may be either air enriched with oxygen or oxygen stored using a continuous oxygen unit. The article gives a method for choosing the optimal parameters of peaking magnetohydrodynamic electric power plants, using the criterion of a minimum value of the specific calculated expenditures. The special characteristics of flow in the channel of a peaking magnetohydrodynamic generator are discussed. The change in

the structure of the specific calculated expenditures for a peaking magnetohydrodynamic unit is investigated as a function of the number of hours per year during which it operates. Dependences of the specific calculated expenditures for a peaking magnetohydrodynamic electric power plant are obtained as a function of the length of the channel for different concentrations of oxygen, time of operation of the unit, and cost of the fuel. The best technical and economic indices are those of a peaking magnetohydrodynamic electric power plant with combustion of the fuel in oxygen. The article discusses means for improving the technical and economic indices of peaking magnetohydrodynamic electric power plants. (auth)

24392 EFFECT OF THE MULTISTAGE FEEDING OF A COLD LIQUID ON THE EFFICIENCY OF AN INJECTOR-TYPE MAGNETOHYDRODYNAMIC CYCLE. Morozov, A. E.; Shpil'rain, E. E. (High Temperature Institute, Academy of Sciences of the USSR). High Temp. 10: No. 5, 974-979 (May 1973).

The article discusses the qualitative effect of the multistage feeding of a cold liquid on the efficiency of an injector-type magnetohydrodynamic cycle. It is shown that the use of a multistage injector can lead either to an increase or to a decrease in the effective efficiency. In addition, the conclusion is also drawn that the introduction of a multistage injector into an optimal single-stage cycle is always advantageous from the point of view of an increase in its efficiency. (auth)

24393 ELECTRICAL CONDUCTIVITY OF A PLASMA COMPOSED OF NATURAL GAS COMBUSTION PRODUCTS SEEDED WITH POTASH. Gaponov, I. M.; Nedospasov, A. V.; Poberezhskii, L. P.; Chernov, Y. G. (Institute of High Temperatures, Academy of Sciences of the USSR). High Temp. 10: No. 5, 992-993 (May 1973).

The construction of large MHD devices requires accurate information about the electrical conductivity of the plasma and the Hall parameter. The results of theoretical and experimental investigations providing accurate information about a plasma composed of natural gas combustion products seeded with potash are given. The specific conductivity of the plasma was measured in the MHD generator duct of the U-02 apparatus by means of Q gages. The accuracy of the temperature measurement was estimated as 1.5%, and that of the conductivity measurements, as 15%. It was found that the conductivity at a prescribed temperature increases insignificantly (5 to 10%) when the seed is introduced in the form of dry K_2CO_3. The conductivity is shown as a function of temperature from 2200 to 2600°K, with different degrees of oxygen enrichment taken into account. (2 figures, 1 table) (RWR)

24394 BRIGHTER PROSPECTS FOR THERMOELECTRIC GENERATORS. Rowe, D. M. (Univ. of Wales, Cardiff). Arch. Energiewirt.; 27: No. 12, 597-606(1973). (In German).

The use of thermoelectric generators in physics and technology is shown. In particular, a review is given on the development of thermoelectric generators which can be heated with radioisotopes. (GE)

24395 MAGNETOHYDRODYNAMIC POWER GENERATION. Energy Dig.; 2: No. 4, 22-23(Jul 1973).

A materials program for magnetohydrodynamic power generation at the US National Bureau of Standards is summarized. Initially the research was concentrated on defining the behavior characteristics of construction, insulating and conductive materials that may be used in MHD, and in characterizing the coal slag that will be flowing through the system. Chemical analysis, x-ray diffraction, petrographic examination, differential thermal analysis and Moessbauer spectroscopy methods are used. Information was also collected on vaporization, viscosity and electrical conductivity of the slag. Properties of seed materials are also being studied. (UK)

24396 USE OF THIN FILM SOLAR CELLS IN THE RADIOVOLTAIC GENERATORS. Bomal, R.; Manin, A.; Steinschaden, K. (CEN, Saclay, France). pp 257-272 of Solar Cells. New York; Gordon and Breach, Science Publishers, Inc. (1971).

From international meeting on solar cells; Toulouse, France (6 Jul 1970). See CONF-700707-.

The performance of thin-film solar cells depends on the characteristics of the radioisotopes and the band-gap of the semiconductor. Tritium sources offer many advantages for radiovoltaic conversion. A one microwatt generator with a design lifetime of 10 y is described. Generators for various applications are considered, giving attention to watches, cardiac pacemakers, and microelectronic power supplies. (TAA)

24397 IMPROVED ANTIREFLECTION COATINGS ON SILICON SOLAR CELLS. Atzei, A.; Capart, J. J.; Crabb, R. L.; Heffels, K. H.; Seibert, G. (European Space Research and Technology Centre, Noordwijk, Holland). pp 349-362 of Solar Cells. New York; Gordon and Breach, Science Publishers, Inc. (1971).

From international meeting on solar cells; Toulouse, France (6 Jul 1970). See CONF-700707-.

The use of silicon monoxide as antireflection coating material on silicon solar cells is the cause of avoidable losses in cell performance. It is shown theoretically that single layer antireflection coatings with materials having a high refractive index such as titanium dioxide can improve cell currents by 5 to 6%. So far improvements of 4% have been realized experimentally. It appears that this gain in performance is retained after electron irradiation. Test results indicate that titanium oxide meets space qualification requirements. (auth)

24398 SOLAR CELLS. Proceedings of the International Colloquium, Toulouse, France, July 6–10, 1970. New York; Gordon and Breach, Science Publishers, Inc. (1971). 659p. (CONF-700707-). $29.50.

Forty-nine papers were presented at the conference. A separate abstract was prepared for each of eight. The remaining forty-one papers and reports of four working groups were not within the scope of NSA. (TFD)

For abstracts of individual papers see: 24396, 24397, and 24596–24601.

24399 DESIGN CONSIDERATIONS FOR HIGH-CURRENT-DENSITY SUPERCONDUCTING SADDLE MAGNETS FOR MHD. Stekly, Z. J. J. (Magnetic Corp. of America, Cambridge, MA); Thome, R. J.; Lucas, E. J.; Cooper, R. F. pp 218-223 of Proceedings of the Fourth International Cryogenic Engineering Conference. Guildford, Eng.; IPC Science and Technology Press Ltd. (1972).

From 4th international cryogenic engineering conference; Eindhoven, Netherlands (24 May 1972). See CONF-720565-.

The major material costs in a superconducting magnet system are the superconductor, the support structure for the magnet and the Dewar. For a given flux density and field volume specification, the cost of each of these items is dependent on the over-all winding current density since this determines the quantity of conductor required and the size of the structure and the Dewar. Graphs are presented which indicate the advantages of high current density on conductor volume requirements and on the coil envelope. The former is a measure of conductor cost and the latter is a measure of structure and Dewar cost. Although high current density implies lower material costs, limitations on current density are imposed by various design considerations. Windings operated at high current densities are particularly sensitive to local heat generation due to sudden relative motion of wires at high stresses. Typical results are given for similar coils operated with and without local support within the winding obtained by impregnation. Finally, a summary is given of the design characteristics of a 5-T saddle magnet with 0.214 m inner dia winding, 0.9 m uniform field length, and over-all winding current density of 1.5×10^8 A/m^2. (auth)

24400 SUPERCONDUCTING MHD MAGNET. Aiyama, Y. (Electrotechnical Lab., Tanashi, Tokyo); Fushima, K.; Yasukochi, K.; Kasahara, T.; Saito, R.; Kimura, H. pp 227-229 of Proceedings of the Fourth International Cryogenic Engineering Conference. Guildford, Eng.; IPC Science and Technology Press Ltd. (1972).

From 4th international cryogenic engineering conference; Eindhoven, Netherlands (24 May 1972). See CONF-720565-.

Details are given of the construction and operation of a superconducting magnet for use in the experimental program being carried out as part of the development of a 1000-kW MHD power generation system. (auth)

24401 DIRECT ENERGY CONVERSION UTILIZING A SUPERCONDUCTING FLUX PUMP. Robertson, R. W.; Irey, R. K. (Univ. of Florida, Gainesville). pp 236-238 of Proceedings of the Fourth International Cryogenic Engineering Conference. Guildford, Eng.; IPC Science and Technology Press Ltd. (1972).

From 4th international cryogenic engineering conference; Eindhoven, Netherlands (24 May 1972). See CONF-720565-.

Conversion of thermal energy directly to an electrical output without the losses associated with intervening mechanical steps is potentially efficient. A technique to accomplish this conversion is discussed in which a material of variable magnetic susceptibility is thermally cycled in the presence of a magnetic field and a suitable designed output coil. Both theory and experimental results are given. (auth)

Facilities and Equipment

Refer also to abstracts 26794, 26797, 26814, 26824, 26853, 26855, 26862, 26870, 26912, 26916, 26918, 26926, and 26946–26950.

24402 (BARC/I-192) DOSIMETRY OF "GAMMA SHINE 1000" INSTALLED AT OSMANIA UNIVERSITY, HYDERABAD. Krishnamurthy, K.; Navada, S. V. (Bhabha Atomic Research Centre, Bombay (India)). 1972. 10p. INIS.

Dosimetry results of a kilocurie ^{60}Co panoramic irradiator called "Gamma Shine", installed at the Department of Genetics at Osmania University, Hyderabad are reported. Analysis of the results obtained and the safety precautions to be taken for the routine operation of the unit are also given. (INIS)

24403 (BNWL-1769) DEVELOPMENT OF A METHOD FOR CORE SAMPLING ALPHA-PLUTONIUM BUTTONS. Final Report. Miller, D. M. (Battelle Pacific Northwest Labs., Richland, Wash.). Jul 1973. Contract AT(45-1)-1830. 35p. Dep. NTIS $4.00.

For Atlantic Richfield Hanford Co.. Richland, WA.

Studies were conducted to determine the feasibility of extracting core samples from alpha-plutonium buttons. A core sample tool was fabricated and tested by the actual cutting of several core samples from the plutonium buttons. Analytical studies demonstrated the superiority of the core drilling system as compared to their twist drill method. Equipment and operating requirements were identified, design concepts were explored and evaluated, and specifications were written. A core sampling machine and tooling were purchased. This equipment was tested and corrections and alterations were made to provide a core drilling system suitable for production sampling of alpha-plutonium buttons. (auth)

24404 (LA-5344-MS) USERS MANUAL FOR IMPAC1: A LUMPED NONLINEAR SPRING COMPUTER PROGRAM TO ANALYZE SHIPPING CONTAINERS SUBJECTED TO IMPACT. Kern, E. A.; Merson, J. L. (Los Alamos Scientific Lab., N. MEX). Aug 1973. Contract W-7405-eng-36. 18p. Dep. NTIS $3.00.

Information is provided for using a computer program designed for the impact analysis of metal shipping containers. The method of analysis, a description of the program routines, and an explanation of the input and output variables are among the items presented. Also included are a number of sample test cases along with a discussion of the results. (auth)

24405 (LA-5354-MS) SYSTEMS AND COST ANALYSIS FOR A NUCLEAR SUBTERRENE TUNNELING MACHINE. A Preliminary Study. Altseimer, J. H. (Los Alamos Scientific Lab., N. MEX). Sep 1973. Contract W-7405-eng-36. 22p. Dep. NTIS $4.00.

The basic system components of large rock-melting Nuclear Subterrene Tunneling Machines (NSTMs) have been conceptualized and defined for a preliminary tunneling cost estimate and comparison with costs using tunnel-boring machines (TBMs) and other conventional tunneling techniques. Two initial types of NSTMs are considered: Type I, peripheral kerf-melting penetrators plus centrally located rotary cutters for soft ground and rock; and Type II, kerf-melting penetrators plus multiple, hot rock-fracturing penetrators for very hard rock. Tunneling costs for NSTMs are very close to those for TBMs, if operating conditions for TBMs are favorable. However, for variable formations and unfavorable conditions such as soft, wet, bouldery ground or very hard rock, the NSTMs are far more effective. Estimates of cost and percentage use of NSTMs to satisfy U. S. transportation tunnel demands indicate a potential cost savings of 850 million dollars (1969 dollars) through 1990. An estimated NSTM prototype demonstration program cost of $100 million over an eight-year period results in a favorable benefit-to-cost ratio of 8.5. The NSTM systems are characterized by large capital costs compared to conventional TBMs. However, many higher-cost items and components are expected to have long service lives and will be used for more than one tunnel project instead of writing off the tunneler after each project as in current TBM practice. The cost of thermal energy for rock melting is not a large percentage of the total project cost. (auth)

24406 (LA-5370-MS) USE OF THE ROCK-MELTING SUBTERRENE FOR FORMATION OF DRAINAGE HOLES IN ARCHAEOLOGICAL SITES. Williams, R. E.; Griggs, J. E. (Los Alamos Scientific Lab., N. Mex.). Aug 1973. Contract W-7405-eng-36. 8p. Dep. NTIS $4.00.

A modularized mobile rock-melting Subterrene was used to produce 50-mm (2-in.)-dia glass-lined drainage holes in archaeological ruins at the Bandelier National Monument, New Mexico. The electrically heated refractory metal penetrators operated in the consolidating mode, i.e., melting the hole and sufficient additional material to accommodate the penetrator by densifying the strata from lower-density soils or rock to dense melt. The required drainage holes were thus made without creating debris or endangering the ruins. (auth)

24407 (LMEC-TDR-73-4) THERMOWELL FAILURE AT SODIUM COMPONENTS TEST INSTALLATION. Marten, W. F. (Liquid Metal Engineering Center, Canoga Park, Calif. (USA)). 30 Mar 1973. 47p. AT.

A sodium fire at the SCTI on August 5, 1972 resulted from sodium leakage through a thermowell located in the primary sodium inlet to the IHX. The thermowell failed while the system was operating at an approximately 32% power level with sodium flowing at ~1800 gpm at 850°F. The failed thermowell (TR-104-62E) was one of two located on an 8-in. by 10-in. stainless steel pipe reducer downstream of, and adjacent to, an 8-in. butterfly control valve in the IHX primary sodium inlet. Examination disclosed a fatigue-type failure which was attributed to vibrational loading conditions that were excessive for the part configuration. (auth)

24408 RESEARCH: H.H.V. PROJECT IN JUELICH. Nucleus (Bonn); No. 26/27, 214-216(1973). (In German).

The high temperature-helium turbine test plant (HHV) which should come into operation in 1975 is described. This plant will not be attached to a nuclear reactor but permits the simulation of the corresponding conditions. It is expected to obtain new technological knowledge from the test results on conventional and unconventional components. (GE)

24409 IMPROVED SPATIAL UNIFORMITY OF BEAM-PLANE INTERACTION BY MEANS OF INVERSE RASTERING. Miller, C. G. JPL Quart. Tech. Rev.; 3: No. 2, 78-90(Jul 1973).

An analysis is presented that shows the desirability and feasibility of conducting irradiations of large test objects by beams of penetrating radiation, by the method of moving the test object back and forth through the beam, rather than by sweeping the beam across the object. An extension of this method of inverse rastering allows the generation of composite beams with any desired intensity-vs-energy spectrum, obviating the need to determine equivalent damage factors for every energy in the spectrum. (auth)

Heat Transfer and Fluid Flow

Refer also to abstracts 24386, 25058, 26478, 26615, 26637, 26663, 26664, 26865, 26901, and 26902.

24410 (AERE-R-6753) EVALUATION OF A RADIOTRACER METHOD OF MEASURING MEAN LIQUID-PHASE VELOCITIES IN AIR-WATER, TWO-PHASE FLOW. Evans, G. V.; Robertson, J. M.; Spackman, R. (Atomic Energy Research Establishment, Harwell (England)). May 1971. 34p. Dep. NTIS (U. S. Sales Only) $3.75. UK 23 pence.

In order to explore the application of radiotracer techniques to the accurate measurement of two-phase, gas-liquid flow, tests have been carried out on an air/water system using the 70 ft. high, 1¼ in. diam. column of the Lotus Loop at Harwell. Sodium-24 was injected into the water film at the base of the column and the passage of the tracer was observed by detectors at four positions along the column. The integrated-pulse-velocity method was used to determine the mean liquid velocity and the results were compared with those deduced from a device which trapped a volume of the mixture between the synchronised valves located at the top of the column. Tests were carried out in the annular and churn flow regimes and reasonable agreement was obtained between velocities determined by the radiotracer and trapped-volume methods. At high gas velocities, a large change was observed in the mean velocity of the liquid-phase along the column which was accompanied by an increasing variation in the measurements of velocity. It is suggested that both effects are caused by the complex flow pattern of annular-dispersed flow. (auth)

24411 EFFECT OF STREAMWISE HEAT CONDUCTION ON HEAT TRANSFER FROM A NONISOTHERMAL FLAT PLATE AT LOW PRANDTL NUMBERS. Sano, T. (Osaka Univ.). Nucl. Sci. Eng.; 52: No. 1, 107-116(Sep 1973).

The effect of streamwise heat conduction on heat transfer from a flat plate was studied at low Prandtl numbers. The surface temperature of the plate was assumed to vary according to a power law with the longitudinal distance. The analysis was performed as a perturbation of the classical boundary-layer theory. The resulting similar energy equations were solved for small Prandtl number by using the method of matched asymptotic expansions. (auth)

24412 VOID FRACTION AND VAPOR AND LIQUID TEMPERATURES: LOCAL MEASUREMENTS IN TWO-PHASE FLOW USING A MICROTHERMOCOUPLE. Delhaye, J. M.; Semeria, R.; Flamand, J. C. (Nuclear Research Center, Grenoble, France). J. Heat Transfer; 95: No. 3, 365-370(Aug 1973).

A technique is described which enables the detection of the phase (liquid or vapor) in steam-water two-phase flow and the tempera-

ture measurement of each phase, using the hot junction of a microthermocouple. The signals are processed with a multichannel analyzer in order to obtain the amplitude histograms of the temperature. Significant results are obtained in pool boiling, forced convection subcooled boiling, and flashing flow of water. (auth)

24413 OPTIMIZATION OF FINNED TUBES FOR HEAT TRANSFER IN LAMINAR FLOW. Hu, M. H.; Chang, Y. P. (State Univ. of New York, Buffalo). J. Heat Transfer; 95: No. 3, 332-338(Aug 1973).

The heat transfer of fully developed laminar flow in internally finned tubes was investigated analytically. If there is no heat generation in the fluid, the highest Nusselt number is obtained for the tube with 22 fins extended to about 80% of the tube radius. Its value is almost 20 times that for the finless tube. When there is heat generation at sufficiently large rate, the number of fins is reduced from 22 to 16 in order to obtain the highest Nusselt number. (auth)

24414 HEAT TRANSFER IN TURBULENT FLUID FLOW IN A TRIANGULAR ARRAY OF RODS. Buleev, N. I.; Mironovich, R. Y. (Physics and Power Institute). High Temp. 10: No. 5, 925-931 (May 1973).

Fluid flows characterized by small Pr numbers are analyzed. The initial equations of motion and energy equations for a fluid flow in an array of rods are solved on the basis of more current equations for the turbulent viscosity coefficient and thermal diffusivity than those used previously. The results of a calculation of the temperature fields in the unit cell cross section are given for various values of the parameters of the problem: the array spacing, Pr number, Re number, and wall-to-fluid thermal conductivity ratio. (auth)

24415 ELEMENTARY THEORY OF CRITICAL (MAXIMAL) FLOW RATES OF TWO-PHASE MIXTURES. Ivandaev, A. I.; Nigmatulin, R. I. (Institute of Mechanics, Moscow State University). High Temp. 10: No. 5, 946-953 (May 1973).

The authors examine the principles of the theory of critical discharge of two-phase mixtures complicated, unlike the one-phase case, by multivelocity and multitemperature effects, and also by effects of variability of the phase composition. A number of models of a dispersed-annular flow regime of a mixture are proposed, on the basis of which substantially different final relations are obtained for determining the flow rates under various discharge conditions. It is shown that for a unique determination of a two-phase critical flow rate for known exit pressure and vapor content, it is necessary to assign additionally a number of parameters which depend on the prehistory of the flow. The possibilities of using the relations obtained are discussed and the relation of the concepts of critical velocity and sound velocity in a mixture is explained. A comparison of the calculation results with the experiments of various authors is made for the example of discharges through long pipes. It is emphasized that only consideration of a practically equilibrium flow of part of the fluid (small liquid drops) with a gas phase, i.e., the use of the dispersed-annular model with a one-velocity two-phase core, permits attaining a good agreement of the theoretical and experimental results at small vapor contents. (auth)

24416 NATURAL CONVECTION IN LIQUID METALS AND ALLOYS. Chiesa, F. Waterloo, Ont.; McGill Univ. (1972). National Library of Canada, Ottawa.

Thesis (Ph. D.).

Natural convective heat transfer was studied for the case of cylindrical columns of liquid metal (Hg and Pb) heated from below and cooled on top (Bénard type convection). The experimental data could be described by a one third power dependence of the Nusselt number on the Rayleigh number when the flow régime was turbulent. It was also found that the rate of vertical heat transfer was substantially affected by sidewall proximity. Experiments involving freezing and melting of a lead column showed that the rate of heat transfer across the convecting liquid was less under transient conditions than under steady state conditions. On the basis of the data obtained, temperature profiles in the cold boundary layer of the liquid could also be established. Finally, the role of the shape of the interface on convective heat transfer rates was ascertained by conducting freezing experiments on lead-tin alloys. It was found that the heat transfer relationships determined for pure lead could still be used provided the upper bounding "interface" was located on the solidus isotherm for planar and cellular growth patterns and the liquidus isotherm for cellular dendritic growth. (Diss. Abstr. Int. B.)

24417 EXPERIMENTAL INVESTIGATION OF THE PHYSICAL MECHANISMS OF DRYOUT IN A HIGH PRESSURE STEAM-WATER SYSTEM. Parsons, C. B. Waterloo, Ont.; Univ. of Waterloo (1972). National Library of Canada, Ottawa.

Thesis (Ph. D.).

Experiments designed to investigate the physical mechanisms of dryout at 1000 and 500 psia were carried out in the FLARE facility at the Chalk River Nuclear Laboratories of Atomic Energy of Canada Limited. The test section consisted of an electrically heated element located concentrically in a vertical shroud. An observation assembly consisting of three window ports was attached to the shroud such that the top two inches of the heater could be viewed. High speed movies coupled with simultaneous surface temperatures and liquid film resistance recordings were taken. Very close agreement was found among the photographic, thermocouple and film resistance data. For a mass velocity of 0.2×10^6 lb/hr ft^2, as the critical heat flux crisis was approached a decrease was observed in the electrical resistance of the liquid film on the heater surface. This was accompanied, simultaneously, by a decrease in heater surface temperature. The observed phenomenon was attributed to the coalescence of the steam bubbles formed on the heater surface and their subsequent departure from the heater surface. As a result, there is an increase in the amount of liquid in the layer at the wall, and, therefore, a slight decrease in the film electrical resistance and heater surface temperature. On further heat addition the flow separated forming dry patches with the remaining liquid concentrated into meandering rivulets. For mass velocities of 0.5×10^6 lb/hr ft^2 and 1.0×10^6 lb/hr ft^2 dryout resulted from a rapid deterioration of the liquid film which was characterized by a very high rate of temperature rise. Adiabatic and diabatic tube film flow rates and heater liquid film thickness measurements are reported. A major portion of the liquid film was found to flow on the unheated tube wall. Adiabatic heater film thickness measurements of the order of .010 to .030 in. were obtained. (Diss. Abstr. Int. B.)

24418 PRESSURE CHANGES DUE TO SHARP CONTRACTION OF SINGLE PHASE OR TWO-PHASE FLOW UNDER THERMAL NON-EQUILIBRIUM CONDITIONS. Kowalski, J.; Mikielewicz, J.; Sliwicki, E. Pr. Inst. Masz. Przeply.; No. 61, 3-12(1973). (In Polish).

Results of an investigation of the pressure drop caused by the abrupt contraction of flow of a single-phase and two-phase medium in thermal non-equilibrium (subcooled boiling) are presented. In both cases Freon-21 was used as the examined medium. The results obtained for the single-phase flow were compared with the Weisbach relation, a good coincidence having been stated and the applicability of the Weisbach relation to different media having been confirmed. Novel relations linking the pressure drop with the flow parameters were derived for the two-phase flow in the thermal non-equilibrium. The relation was written in the form of a dimensionless equation and examined experimentally. As may be inferred from the location of the measuring points, the dependence of $1 - \Delta p_{tz}/\Delta p_{xz}/1 - p_p/p_c$ on the parameter $t_{sw} - t_n/t_{sw} - t_F$ is confirmed. (auth)

24419 FLUID VELOCITY PROFILES AT THE INLET OF A CLOSELY PACKED BUNDLE OF RODS. Bibikov, L. N.; Levchenko, Yu. D.; Subbotin, V. I.; Ushakov, P. A. At. Energ. (USSR); 35: No. 1, 19-24(Jul 1973). (In Russian).

Measurement results of air-flow velocity profiles at the inlet of a closely packed bundle of rods in the range of Reynolds numbers from 15×10^3 to 75×10^3 are presented. The stabilization length of velocity profiles in a channel is obtained. Experiments were performed under three different conditions of channel inlet: an inlet with a sharp edge, a smooth inlet, and an inlet through an orifice tube plate of a bundle. A method of measuring velocity profiles and stabilization length is described. (auth)

24420 EXPERIMENTAL STUDY OF THE LAMINAR-FLOW HEAT TRANSFER COEFFICIENT OF A FLUID WITH A PRESCRIBED WALL HEAT FLUX. Reisman, O. I. New York; New York Univ. (1973). 94p. University Microfilms Order No. 73 19,401.

Thesis (Ph. D.).

An analytic solution for a step-varying wall heat flux was derived and verified experimentally. The apparatus consisted of a stainless steel test tube, surrounded by an electric heating cable and heat insulation. This tube was connected to a closed circuit system, containing a pump, reservoir, heat exchanger, control valves and flow-meter. General Electric transformer oil was used as the fluid passing through the system. Thermocouples measured the test tube temperatures as well as the fluid entrance and exit temperatures. Before assembly of the apparatus the following calculations were made: entrance section length, test section length, and reservoir capacity. A number of tests were also run before assembly, such as thermocouple calibration, testing of heating cable, optimization of thermal insulation, and measurement of the oil viscosity at various temperatures. After assembly, the heat transfer experiment was performed, and the wall and fluid temperatures, as well as other pertinent data were recorded. The oil flow was maintained constant until all temperatures reached steady state condition. The experiment was repeated to assure invariance with time of the data. The measured wall temperatures were then compared with the the-

oretical solution at three points along the tube. Good agreement was found at two of the points where the experimental data differed by less than 6% from the theoretical curve. At the third point, however, the average difference was 25%. (Diss. Abstr. Int., B.)

24421 GENERATION, MOVEMENT, AND DEPOSITION OF DROPLETS IN ANNULAR TWO-PHASE FLOW. Chang, D. R. C. Newark, DE; Univ. of Delaware (1973). 253p. University Microfilms Order No. 73-20,053.

Thesis (Ph. D.).

The gas velocity, liquid velocity and the film depth for water, glycerine solutions and isobutanol solutions were determined at the inception of atomization in a rectangular channel. The distribution functions and the statistical parameters of the orientation angle and the initial velocity of the droplet motion as well as those of droplet size were measured in a rectangular channel. The photographic tracing technique by a high speed movie camera was used in this experimental study. A mathematical model is proposed for the droplet motion in the gas stream. A direct Monte Carlo simulation is performed to imitate the droplet generation, movement and deposition in annular two phase flow. The simulated circumferential interchange, the residence time and the residence length are compared with the experimental data. The experimental analysis and the mathematical computation confirm that most of the droplets entrained from a wave crest are of such a size that they travel in the gas stream on a trajectory flight, rather than in random motion with the turbulent eddies. (Diss. Abstr. Int. B.)

24422 DIFFUSION AND PLATEOUT OF LEAD-212 (ThB) IN LAMINAR FLOWS OF AR, HE, O_2, AND C_3H_8. Crotzer, M. E. University Park; Pennsylvania State Univ. (1972). 148p. University Microfilms Order No. 73-20,073.

Thesis (Ph. D.).

To clarify some factors influencing the diffusion and plate-out of radon daughters from laminar air streams, two methods were used to analyze the diffusion and plateout of the thoron daughter lead-212 (ThB) from isothermal laminar flows of Ar, He, O_2, and C_3H_8. The effect of trace quantities of O_2 and H_2O on ThB plateout in Ar and He was also studied. In the first method (differential decay method) the bulk gas carries ThB into a tube. A ThB diffusion coefficient can be obtained from the mathematical description of ThB plateout on the tube walls. In the second method (filter method) the bulk gas carries radon-220 (thoron), but not ThB into a tube. ThB is created in the flowing gas due to thoron decay, and subsequently deposits on the tube wall. From a mathematical description of the ThB buildup and plateout, a ThB diffusion coefficient and the thoron concentration can be obtained. The age of ThB (elapsed time since formation) is different in the two methods. "Old" ThB in the differential decay method is several minutes old, while "new" ThB in the filter method is only one or two seconds old. The experimental ThB plateout profiles agreed with the theoretical plateout expressions for both the filter and the differential decay method. A comparison of the experimental diffusion coefficients with predicted values gave the following estimation of the size and nature of old and new ThB in each gas. In O_2 and Ar, new ThB very likely exists as an ion, atom, or oxide of lead. The size of old ThB in Ar and He and new ThB in He is about twice the expected size of a PbO_2 molecule. The probable form of new ThB in C_3H_8 is a lead atom or ion. Shortly after formation, the ThB apparently reacts with the C_3H_8 to form $Pb(C_3H_7)_4$. Old ThB in O_2 has a distribution of particle sizes, all much larger than the size of new ThB in O_2. Particle formation seems to result from the ThB reactions with O_2 and trace H_2O and not by ThB atoms depositing on aerosol particles. The formation of ThB particles was also observed in Ar-O_2 and Ar-H_2O mixtures. There was, however, no ThB particle formation in He-O_2 and He-H_2O mixtures. The diffusion coefficients obtained for new ThB in O_2 and Ar agree with the commonly accepted literature value for radon daughters in air (0.054 cm^2/sec). The form of the daughter having this diffusion coefficient is most likely an ion, atom, or oxide, and not a water cluster as previously suggested. The formation of large-sized radon daughter particles in air (D approximately 1×10^{-3} cm^2/sec) may be due to daughter reactions with O_2 and H_2O rather than daughter atoms plating out on aerosol particles as previously suggested by others. (Diss. Abstr. Int. B.)

24423 INFLUENCE OF FLUTE PROFILE UPON BOILING HEAT TRANSFER ON DOUBLY-FLUTED VERTICAL SURFACES. Butt, F. H. College Station, TX; Texas A and M Univ. (1973). 155p. University Microfilms Order No. 73-21,647.

Thesis (Ph. D.).

Overall and individual boiling and condensing film heat transfer coefficients were measured for a water film flowing down along the surface of steam-heated vertical smooth and grooved copper plates for a constant saturation temperature of 215°F. A right-angle, isosceles triangular groove profile was selected with a pitch-to-depth ratio of two. The pitch of each of the three profiles varied by a factor of two from one to the other. The ranges of overall temperature difference, ΔT, and feed flow rate (5 to 25°F and 1.015 to 1.760 GPM) were chosen to approximate those employed in desalination evaporators using enhanced heat transfer tubes. The corresponding wall superheat, ΔT_s, ranged from about 2.86 to 15.1°F. Two distinct modes of boiling were observed, i.e., surface evaporation corresponded to lower range of ΔT_s, and nucleate boiling dominated at higher range of ΔT_s. The boiling film coefficient for profile 1 (with the deepest grooves) was about 2.25 to 3.0 times higher than that of the flat plate, and for both profiles 2 and 3, it was about 1.63 to 2.5 times higher. There was practically no difference in the boiling heat transfer performance of profiles 2 and 3. In the film evaporation region, the coefficient for the flat plate showed a rather strong dependence on the wall superheat, whereas the dependence of profiles 1, 2, and 3 was only marginal or insignificant. In the nucleate boiling region, the coefficient for all plates showed a strong dependence on the wall superheat, being the strongest for flat plate and weakest for profile 1. The boiling film coefficient showed no significant dependence on the film Reynolds number (or flow rate). The ratio of film thickness, δ, to the groove depth, D, was found to be of significance. For $\delta/D > 1$ (which was the case for profiles 2 and 3 whose peaks were completely submerged at all flow rates), the coefficient was insensitive to this ratio and depended only on the wall superheat. For $\delta/D < 1$ (the case of profile 1 whose peaks were not inundated but were constantly washed by the liquid film), the coefficient was significantly higher at all wall superheats and appeared to be a function of this ratio. (Diss. Abstr. Int., B.)

Materials Testing

Refer also to abstracts 25056, 25091, 26566, 26854, 26860, and 26910.

24424 (BNWL-383) DEVELOPMENT OF NONDESTRUCTIVE TESTING METHODS FOR NASA TUNGSTEN, WATER-MODERATED REACTOR FUELS. Volume I. Program Summary. Final Report. Spanner, J. C.; Brown, R. L. Jr. (comps.) (Battelle Northwest, Richland, Wash. Pacific Northwest Lab.). Sep 1966. Contract AT(45-1)-1830. 85p. (NASA-CR-72139). Dep. NTIS $6.25.

Declassified 9 Apr 1973.

The applicability of ultrasonic, eddy current, and nuclear nondestructive testing techniques for the detection and measurement of several quality parameters in tungsten-UO_2 fuel elements was investigated during this two-year program. The results of experiments to measure fuel loading, fuel distribution, core integrity, cladding thickness and integrity, and physical dimensions are given. Developmental test equipment systems are described, and comparisons between the various test methods are made. (auth)

24425 (BNWL-384) DEVELOPMENT OF NONDESTRUCTIVE TESTING METHODS FOR NASA TUNGSTEN, WATER-MODERATED REACTOR FUELS. Volume II. Test Method and Equipment Summary. Final Report. Spanner, J. C.; Brown, R. L. Jr. (comps.) (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Apr 1967. Contract AT(45-1)-1830. 167p. (NASA-CR-72140). Dep. NTIS $10.50.

Declassified 9 Apr 1973.

Systems which were developed to provide adequate quality assurance capabilities for the fuel designs proposed for the NASA tungsten, water-moderated, nuclear rocket concept are described. Program objectives are defined, significant fuel quality parameters are listed, and a detailed description of the experimental work which was conducted during the development, evaluation, and limited application of each system is provided. Methods investigated included ultrasonic, eddy current, nuclear counting, autoradiography, and x-ray radiography. Optical and mechanical techniques were also developed in an effort to provide an adequate array of quality assurance methods and procedures. (auth)

24426 (GULF-GA-A-12521) EQUIPMENT AND TECHNIQUES FOR THE UTILIZATION OF NEUTRON RADIOGRAPHY WITH THERMIONIC FUEL ELEMENTS. Schwarzer, D. E.; Fitzpatrick, G. O. (Gulf General Atomic Co., San Diego, Calif.). 26 Mar 1973. Contract AT(04-3)-840. 31p. Dep. NTIS $4.00.

With the aid of neutron radiography, the periodic nondestructive examination of highly radioactive thermionic fuel elements and fuel-clad tests has been possible. These examinations have allowed the observation of fuel and structural changes as a function of time and have greatly facilitated diagnostics during testing. The data acquired often allows design changes to be made more than

one year earlier than would normally be possible using information obtained from the hot cell examination after testing has been terminated. (auth)

24427 (UCRL-13569) STRESS ANALYSIS OF WELDED JOINTS WITH PARTICULAR REFERENCE TO CIRCUMFERENTIAL WELDS IN CYLINDERS. Finnie, I.; Vaidyanathan, S. (California Univ., Berkeley. Coll. of Engineering). 1972. 75p. Dep. NTIS $5.75.

The residual stress distribution produced by a circumferential weld between axisymmetric shells (cylinders, spheres, cones, etc) is quite different from that due to a butt weld between two flat plates. The reason for this difference is pointed out and it is shown that the state of stress in the shells may be estimated from that in the plates. Since a simple approximate method for predicting residual stresses due to butt welds is available, it is possible to estimate the stresses due to a circumferential weld from the welding conditions and certain material properties. Experimental results on electron beam welded aluminum parts show good agreement with the predictions. Results were obtained for a full penetration, single pass weld with no variation of alloy content across the weld. It is shown that this approach may be extended to cover a wider variety of weld conditions. It is seen that multipass welds, partial penetration welds and welds with filler metal differing greatly in properties from the base metal can all be taken into account. Experimental results for beryllium cylinders welded with aluminum filler metal are presented to support the proposed method of analysis. The stresses imposed by the striking of an arc, the initial phase of the welding process, were examined. When an arc is discharged against a flat plate, under controlled conditions, the resulting residual stress pattern may be predicted. If a crack is introduced either artificially, or naturally by cooling of the molten zone, the extent of crack propagation depends on the fracture properties of the material. It is shown that this may be studied using two types of simple fracture tests. In one, a small specimen is constrained by a rigid fixture. The absence of crack propagation after the arc is struck can be used to place a lower bound on fracture toughness. In the other type of test, a somewhat larger specimen is completely unconstrained during arc discharge. The extent of cracking can then be used to estimate a fracture toughness for crack arrest. Experimental data are given to illustrate both types of tests. (auth)

24428 (WAPD-TM-984) IMPROVED FIRST ORDER ANALYSIS OF THE PLASTIC STABILITY OF DIFFUSE PATCHES IN TUBES AND SHEETS (LWBR DEVELOPMENT PROGRAM). Duncombe, E. (Bettis Atomic Power Lab., Pittsburgh, Pa.). Aug. 1973. Contract AT-11-1-GEN-14. 12p. Dep. NTIS $3.00.

Previously published work on plastic instability of patches in tubes and sheets under biaxial stress conditions is extended by the use of improved first order approximations and more general material property relationships. The former relates to the inclusion of first order changes in the strain direction inside the patch and the latter relates to the inclusion of material anisotropy and strain rate sensitivity (defined in the text). Inclusion of strain directors changes the form of the characteristic equation for stability from first order to second order but both roots are real for all practical cases. For some stress conditions the largest root is positive at all values of strain hardening parameter (defined in the text). However, the values of strain hardening at which the largest root becomes significantly positive are very close to those reached for zero root when changes in strain directors are ignored. By this significance test the stability also increases rapidly above a strain rate sensitivity of about 0.1. (auth)

24429 BETAGRAPHY AND RELATED TECHNIQUES USED FOR THE EXAMINATION OF PAPERS AND THIN FOIL MATERIALS. Boutaine, J. L.; Lemonnier, A. (CEN de Saclay, Gif-sur-Yvette, France). Bull. Inform. A.T.E.N. (Ass. Tech. Energ. Nucl.), Suppl.; No. 97, 18-26(Sep 1972). (In French).

The principal characteristics of β emitters used in beta radiography are presented. The techniques used to obtain pictures are described together with the different domains in which the method is applicable. The neighboring radiographic techniques are presented: electron radiography, x-ray radiography, secondary electron emission radiography, and autoradiography. (FR)

24430 REVIEW OF THE TECHNOLOGY OF IN-SERVICE INSPECTION. Lautzenheiser, C. E. (Southwest Research Inst., San Antonio). pp 247-256 of III Interamerican Conference on Materials Technology. Buenos Aires; Centro Regional de Ayuda Tecnica (1972).

From 3rd Inter-American conference on materials technology; Rio de Janeiro, Brazil (14 Aug 1972). See CONF-720832-.

A review is presented of the technology of in-service inspection starting with the early efforts on the Elk River reactor pressure vessel, up to the latest technology. Techniques and equipment utilized for OD and ID inspection of light water-moderated systems and OD inspection of heavy water-moderated systems are described. Difficulties encountered with inspection of dissimilar metal welds, stainless steel welds, and inspection of heavy weld components are covered in detail. The analysis techniques utilized for determining the size and character of indications in heavy section materials are discussed relative to actual flaws detected in nuclear reactor pressure vessels. (15 figures, 10 references) (auth)

Nuclear Explosions

Refer also to abstracts 24502, 24605, and 26766.

24431 (AD-746328) STUDY OF ACOUSTIC-GRAVITY WAVE GENERATION BY NUCLEAR DETONATIONS. Final Report, 16 February 1971-15 February 1972. Kahalas, S. L.; McLaren, T. I.; Murphy, B. L. (Mount Auburn Research Associates, Inc., Newton Upper Falls, Mass. (USA)). 15 Apr 1972. Contract F44620-71-C-0086. 81p. (AFOSR-TR-72-1331). NTIS.

Conclusions based on previous work are reviewed. The earlier work treated the generation and propagation of both long period (3 to 10 min) and short period (1 to 60 s) acoustic signals from nuclear detonations. Also included in the review are conclusions reached concerning Rayleigh wave generation by atmospheric explosions. Recent work is then described. This consists of an analysis of the relationship of different kinds of disturbance seen in the ionosphere to the hydrodynamic motions accompanying a low altitude nuclear explosion, in which both the detonation blast wave and the buoyant rising fireball are considered as sources of ionospheric disturbance, and a laboratory investigation of the internal gravity waves generated by buoyant rise in a density stratified medium. (auth)

24432 (AD-760556) SPECTRAL ANALYSIS OF INFRASONIC WAVES GENERATED BY HIGH-ENERGY EVENTS. Appendix I. Final Report, 1 June 1970-31 October 1971. Ocola, L. C.; Montes, H. A. (Instituto Geofisico, Lima (Peru)). Dec 1971. 22p. (AFOSR-TR-838(App. 1)). NTIS.

The spectral analysis of infrasonic waves generated by nuclear explosions is given. (NTIS)

24433 (LA-4541) NUCLEAR PULSED SPACE PROPULSION SYSTEMS. Balcomb, J. D.; Booth, L. A.; Cotter, T. P.; Hedstrom, J. C.; Robinson, C. P.; Springer, T. E.; Watson, C. W. (Los Alamos Scientific Lab., N. Mex.). Oct 1970. Contract W-7405-eng-36. 34p. Dep. NTIS $3.75.

Declassified 29 Aug 1973.

Initial considerations are presented for advanced space-propulsion concepts that are based on energy production by laser-driven thermonuclear pulses. Preliminary design concepts are compared in which an individual pulse unit, located either internally or externally to the system, imparts an impulse to the spacecraft. Many pulse units are sequentially discharged and initiated until the desired spacecraft velocity is reached. Various means of shock absorption and shielding against fast neutrons generated by the thermonuclear reactions are investigated. Indications are that the maximum specific impulse for an internal system would be ~2500 s, whereas that for an external system might attain ~7500 s. (auth)

24434 (LA-5273) ITERATIVE PROCEDURE FOR ALIGNMENT IN UNDERGROUND NUCLEAR TESTING. Kern, E. A. (Los Alamos Scientific Lab., N. Mex.). Aug 1973. Contract W-7405-eng-36. 10p. Dep. NTIS $4.00.

A new method is presented for determining the mounting geometry for a frustum within the tunnel of an underground nuclear testing site. This method is based on a sequence of linear iterations in conjunction with a Davidon iterator for finding the minimum of a function of several parameters. Successful convergence of the method has been demonstrated on a time-sharing CDC 6600 computer. This method could be generalized to other similar alignment problems. (auth)

24435 (SLA-73-43) GROUND MOTION IN THE VICINITY OF THE CANNIKIN NUCLEAR EXPLOSION. Perret, W. R. (Sandia Labs., Albuquerque, N. Mex.). Sep 1973. 80p. Dep. NTIS $5.45.

The Cannikin event was an underground nuclear explosion detonated November 6, 1971, 5875 feet beneath Amchitka Island in a chamber mined in pillow lava. Surface and subsurface ground motion observations made during this event by Sandia Laboratories are reported. Subsurface motion was obtained from a vertical array of nine stations distributed in Boring UAe-1 offset 299 feet from the shot hole, Boring UA-1, at slant ranges between 2473 and 5780 feet from the explosion. Twelve surface

motion stations were distributed at horizontal distances between 49 and 34,227 feet from surface zero. Data from these stations were limited to a period of 1.81 second after detonation by power failure at the recording trailer, except as the deeper surface records were truncated earlier by circuit failures, probably cable damage. Useful data were obtained from all but the most remote surface station, where power failure preceded signal arrival. Subsurface data did not include peak displacement below 200 feet, but acceleration and particle velocity peaks were derived from all stations. Net stress spall analysis for all stations and differential displacement curves for the upper three stations were feasible. These suggest some expansion between the surface and the shallowest station, a major but late spall parting between 100 and 200 feet and initial spall near 330 feet, with consequent cable failure at the station directly above that point. Surface motion was generally typical with the exception of minor inward initial motion at the stations nearest surface zero. Stations located at the near and far sides of two faults indicated early differential motion, but power loss prevented observation of residual displacements at these and all other stations. Data from two surface stations operated by other agencies, one adjacent to the most remote Sandia station, the other offset about 2100 feet from surface zero, were made available for this report and are included. These data, unaffected by the power failure, serve to verify the truncated Sandia data. (auth)

24436 (SLA-73-484) BLAST PREDICTIONS AND MICROBAROGRAPH MEASUREMENTS, PROJECT MIDDLE GUST FINAL REPORT. Reed, J. W. (Sandia Labs., Albuquerque, N. Mex.). Aug 1973. 61p. Dep. NTIS $5.25.

Blast predictions, based on a weather watch, were provided for five Project Middle Gust explosives tests, of 20- and 100-ton chemical high-explosives yields near Ordway, Colorado. The intent was to avoid firing in weather conditions which could, through ducting or focusing of blast waves by atmospheric refraction, unnecessarily disturb the neighboring population. Recommendations were also made to help minimize close-in damage and prevent any hazard to both project and non-project personnel and aircraft. Most blast-wave amplitudes recorded at nearby communities (6 to 26 km) were held well below standard explosion values by firing only with strong sound velocity/height gradients, which refract the blast waves away from ground level. At close-in ranges, although some vulnerable panes were boarded over, entire house frames were significantly racked by blast and breakage occurred. Combined with weather effects, however, total window damage was held much below what would have been expected had no safety measures been taken. (auth)

24437 (VUF-1042) ANALYSIS OF AQUIFER RESPONSE FOR THE STERLING EVENT, TATUM DOME, LAMAR COUNTY, MISSISSIPPI. Vela Uniform Program: Project Dribble. Final Report. Dudley, W. W. Jr.; Baldwin, D. A.; Baker, V. R. (Geological Survey, Washington, D. C.). May 1973. 25p. Dep. NTIS $4.00.

The Sterling Event, a 0.35-kt nuclear explosion 823 m below the surface in the Tatum salt dome in Mississippi, was conducted as part of the U. S. Department of Defense research program to detect underground explosions. The Sterling device was decoupled from the salt by suspending it in a spherical cavity 34 m in dia, formed by the earlier 5-kt Salmon Event. At a distance of 1 km from the explosion, the resulting seismic motion was reduced by a factor of about 60, as compared to the motion predicted for a fully tamped emplacement. Seismically generated, confined fluid-pressure responses in four observation wells, however, were reduced below predicted values only by a factor of 2 to 11.3, depending on the scaling exponent applied to device yield in the prediction equations. The fluid-pressure response to the Sterling Event therefore was reduced less by decoupling than was the seismic motion. The frequency of the fluid-pressure fluctuations was lower than expected, and the efficiency of the observation wells as hydroseismic detectors consequently was greater than anticipated. (auth)

24438 LOCAL SEISMIC PHENOMENA IN THE FIRST THREE SECONDS AFTER UNDERGROUND NUCLEAR EXPLOSIONS. **Boucher, G. (Seismological Laboratory, Mackay School of Mines, University of Nevada, Reno, Nevada, 89507). J. Geophys. Res. 78: No. 8, 1348-1360 (10 Mar 1973).**

Accelerograms obtained at distances under 100 km from four underground nuclear explosions in Nevada (Benham, Greeley, Knickerbocker, and Faultless) were studied to determine the possibility of identifying secondary seismic events immediately following the explosion. The purpose of the investigation was (1) to determine the minimum amount and quality of data needed to perform such an analyis and (2) to try to identify any such secondary events, such as those associated with ground faulting, if possible. The records were digitized at 40 points/sec for 3 sec and then analyzed by various filtering and array-processing techniques to try to pick out significant arrivals from events subsequent to the explosions. The ten usable accelerograms available from each of the Nevada Test Site events Greely and Benham proved inadequate for any definite conclusions, although there is a strong suggestion that two events were identifiable in the case of Benham. The first was a possible normal faulting event less than 0.2 sec after the explosion and near to it, and the second is associated with long-period arrivals appearing to originate a few kilometers to the southwest of Benham, which are likely to be associated with one of the major aftershock zones observed for this explosion. Of the 24 records available for the Faultless explosion, more than half were considered to be of good quality for this analysis. A technique using all the accelerograms to search a 4- by 4-km area around the explosion for events with particular assumed focal mechanisms was developed, and in at least one case it appears to have demonstrated an earthquake-type event that occurred about 1 km from the explosion and about 1.5 sec after it. Also the surface reflection of the compressional wave was identified with some certainty, although the possibility exists (but is considered less likely) that a normal-faulting type of event very near the shot point could be mistaken for this surface reflection. The conclusion was that a minimum of perhaps fifteen such accelerograms of ideal quality, with station distributions chosen carefully within a 100-km radius, could be used to identify with certainty secondary seismic events with amplitudes as small as one-quarter that of the largest event and that such techniques might also be applicable to a natural earthquake as well as to explosions, although the earthquake would present certain additional problems. (auth)

Protective Structures and Equipment

Refer also to abstract 26951.

Safety Engineering

Refer also to abstracts 24407, 24672, and 26945.

24439 (AERE-R-6710) MECHANICAL LOCK-ON X-RAY SAFETY SHUTTER FOR THE PHILIPS PW 1016 TUBESHIELD. Sampson, C. F. (Atomic Energy Research Establishment, Harwell (England)). Feb 1971. 9p. Dep. NTIS (U. S. Sales Only) $3.00. UK 13 pence.

A brief illustrated description is given of a lock-on x-ray safety shutter for the Philips PW 1016 tubeshield. The shutter relies on the action of the collimator to depress the center steel stud when the camera is pressed against the face of the safety device. The outside knurled ring of the shutter can then be turned to the open-beam position. In doing so the camera is locked on to the x-ray tubeshield and cannot be removed while the shutter is in the open-beam position. For film processing or specimen change, the knurled ring must be rotated to the central position, cutting off the incident x-ray beam and releasing the camera at the same time. The knurled ring has six beam-open positions corresponding to six filter positions originally supplied by the manufacturers. The magnetically operated lead shutters can still be used as originally supplied. Radiation surveys made with powder and oscillation cameras in position and the instrument operating at 40 kV-20 mA Cu kα indicated levels of <0.1 mR/hr. With no camera in position, levels were 1.1 mR/hr over the collimator/beam exit position, and 0.12 mR/hr over the top edge of the shutter and body of the x-ray tube shield. (UK)

24440 (ORNL-TM-4313) SAFETY WITH HIGH MAGNETIC FIELD SYSTEMS. Luton, J. N. Jr. (Oak Ridge National Lab., Tenn.). Sep 1973. Contract W-7405-eng-26. 28p. Dep. NTIS $3.50.

Based on a consideration of the laboratory environment and on the physical characteristics of high field magnet coils and of humans, some hazards and safety precautions concerning steady state magnet systems are discussed. (auth)

24441 FOURTH SYMPOSIUM ON CHEMICAL PROCESS HAZARDS WITH SPECIAL REFERENCE TO PLANT DESIGN. Conference Held at Manchester, England, April 6, 1971. Institution of Chemical Engineers Symposium Series, No. 33. London; Institution of Chemical Engineers (1972). 113p.

Fourteen papers were presented. A separate abstract was prepared for each of 2. The remaining 12 papers on gas explosion hazards and hazardous materials in industrial plants were not within the scope of NSA. (LCL)

For abstracts of individual papers see: 24442 and 24443.

24442 FIRE SAFETY CONSIDERATIONS RELATED TO THE LARGE SCALE USAGE OF SODIUM. Bulmer, G. H. (United Kingdom Atomic Energy Authority, Risley, Eng.). pp 79-89 of Fourth Symposium on Chemical Process Hazards with Special

Reference to Plant Design. London; Institution of Chemical Engineers (1972).

From 4th symposium on chemical process hazards with special reference to plant design; Manchester, England (6 Apr 1971).

Sodium reacts with most of the substances which are in general use as fire-fighting media. Its ignition temperature varies between ambient and 400°C. When burning, the effects of temperature and radiant heat are less for sodium than for combustion of an equivalent volume of carbonaceous materials. However, fires involving Na are characterized by the copious evolution of caustic fumes which reduce visibility quickly and makes fire fighting by manual means difficult, if not impossible. Fire safety is achieved by a combination of good plant design and an automatically operating installation. Support facilities are required for decontamination work and for waste disposal. Preplanning and safety control are necessary if injury to personnel engaged in these activities is to be avoided. (auth)

24443 QUANTITATIVE ASSESSMENTS OF SYSTEM RELIABILITY. Green, A. E. (United Kingdom Atomic Energy Authority, Risley, Eng.). pp 103-108 of Fourth Symposium on Chemical Process Hazards with Special Reference to Plant Design. London; Institution of Chemical Engineers (1972).

From 4th symposium on chemical process hazards with special reference to plant design; Manchester, England (6 Apr 1971).

In the design and operation of plants in various fields of application, including nuclear reactors, there is an increasing need to assess, with the minimum of subjectiveness, the reliability of systems. This need arises in various ways such as safeguarding capital investment in a plant or reducing risk to human life. Some aspects of the prediction of the reliability of protective systems are discussed using quantified reliability techniques. (auth)

24444 UWAGA: SUBSTANCJE PROMIENIOTWORCZE. (Danger: Radioactive Substances). Stepien, A.; Zajdel, J. A. (Warsaw; Instytut wydawniczy (1972). 128p. 15 Zlotys.

Radiation safety for supervisors, safety officers, factory inspectors, and persons working with radioactive substances is discussed. A review of the types of radiation and the properties of ionizing radiation is followed by a description of the physiological effects and the prevention of irradiation and contamination. Incorporation of radioactive material during the handling of unsealed sources is considered and the relevant safety measures indicated. A special chapter is devoted to the characteristics of the most common isotopes, their industrial uses, the maximum permissible doses and the measuring instruments to be used. The relevant Polish legislation and standards are indicated. (Occup. Saf. Health Abstr.)

24445 FIRE OFFICER'S GUIDE TO DANGEROUS CHEMICALS. Bahme, C. W. Boston; National Fire Protection Association (May 1972). 256p. $8.50.

This book provides fire officers with the basic information required for handling emergencies involving dangerous chemicals. The material is arranged under the following headings: combustible chemicals; oxidizing chemicals; air- and water-reactive chemicals; unstable chemicals; explosives and blasting agents; cryogenic chemicals; rocket propellants; corrosive chemicals; toxic chemicals; halogens and halogenated hydrocarbons; and radioactive chemicals. (Occup. Saf. Health Abstr.)

24446 HAZARDOUS LOADS. Leicester, Eng.; Institution of Fire Engineers (1972). 267p. £0.90.

The information in this handbook, which is intended for all those called upon to deal with incidents involving hazardous conditions, is presented in simple form and provides a quick and easy reference for those attending incidents involving hazardous substances. Chemicals are listed in alphabetical order, and the information given in tabular form covers the properties; emergency procedures; and extinguishing agents. The book also contains a summary of precautions to be observed when dealing with incidents involving chemicals and radioactive materials; general first-aid precautions; and notes on aerosols and carbon tetrachloride. (Occup. Saf. Health Abstr.)

Vacuum Engineering

Refer also to abstract 25311.

ENVIRONMENTAL AND EARTH SCIENCES

24447 RADIOACTIVE FALLOUT IN PRAGUE IN 1971. Spurny, K.; Holy, E. (Inst. of Physical Chemistry, Prague). Zdrav. Tech. Vzduchotech.; 15: No. 4, 197-199(1972). (In Czech).

Results are tabulated of the measurement of radioactive fallout in Prague in 1971. (INIS)

Minerals and Ores

Refer also to abstracts 24460, 24461, 24473–24476, 24482, 26773, 26924, and 26936.

24448 (GJO-103(73)) URANIUM EXPLORATION EXPENDITURES IN 1972 AND PLANS FOR 1973–1974. (Grand Junction Office (AEC), Colo.). May 1973. 9p. Free GJO.

Results of a survey of 1972 uranium exploration expenditures made by the U. S. Atomic Energy Commission are presented. The data presented are the compilation of the replies received from 84 companies whose exploration activities accounted for about 97% of the 1972 surface drilling previously reported to the AEC on a monthly basis. Information on land acquisition, surface drilling, and other exploration expenditures, which totaled $32 million in 1972 is tabulated. Planned exploration expenditures for 1973 and 1974 are also given. (JGB)

24449 (GJO-104(73)) POTENTIAL URANIUM RESOURCES OF THE WESTERN UNITED STATES. (Grand Junction Office (AEC), Colo.). May 1973. 8p. Free GJO.

An AEC evaluation of industry exploration activity in the western U. S. is presented. Estimations of reserves and potential resources of uranium as of Jan. 1, 1973 are tabulated. (JGB)

24450 (GJO-106(73)) PRODUCTION CAPABILITY OF THE U. S. URANIUM MINING INDUSTRY. (Grand Junction Office (AEC), Colo.). May 1973. 9p. Free GJO.

The overall uranium supply and demand situation is discussed. It is noted that requirements can be met through 1979, after which there is a general fall-away of capability and a sharply increasing gap between capability and requirements. It is pointed out that because of a lead time of 4 to 11 years before production from new sources can begin, a continuing effort must be made to discover new sources. (JGB)

24451 (TID-26356) PRELIMINARY REPORT ON THE GEOLOGY OF URANIUM DEPOSITS IN THE BROWNS PARK FORMATION IN MOFFAT COUNTY, COLORADO, AND CARBON COUNTY, WYOMING. Ormond, A. (Division of Raw Materials (AEC), Denver, Colo. Denver Area Office). Jun 1957. 42p. Dep. NTIS $4.25.

Uranium was first discovered in the Browns Park Formation in 1951 in the Miller Hill area of south-central Wyoming. Since that time economically important deposits in this formation have been discovered and developed in the Poison Basin of south-central Wyoming and in the Maybell area of northwest Colorado. The Browns Park is the youngest formation (Miocene) in the region and overlies older rocks with angular unconformity. The formation consists of a basal conglomerate, fluviatile, lacustrine, and eolian sandstones, and locally a few thin beds of clay, tuff, and algal limestone. The sandstones are predominantly fine- to medium-grained and consist of quartz grains, scattered black chert grains, and interstitial clay. The uranium deposits are of the sandstone-impregnation type and are not confined to specific stratigraphic horizons. The important ore minerals are autunite and uranophane in oxidized sandstones, and uraninite and coffinite in unoxidized sandstones. Uranium is often associated with limonite and calcium carbonate in concretionary forms. Woody material, thought to play an important part in the deposition of uranium in many sandstone-type deposits, is not present in the deposits of the Browns Park Formation. However, organic carbon in the form of petroleum and petroleum residues has been observed in association with uranium in both the Poison Basin and the Maybell areas. (auth)

24452 MOESSBAUER SPECTROSCOPY OF IRON COMPOUNDS PRESENT IN URANIUM CONTAINING SANDSTONES. Frank, E.; Labenski, F.; Sargovi-Badler, C. (Comision Nacional de Energia Atomica, Buenos Aires). Radiochem. Radioanal. Lett.; 14: No. 5-6, 349-356(5 Sep 1973).

Iron bearing materials which are found together with different kinds of uranium ores were identified as maghemite or hematite and a chlorite-like material using Moessbauer spectroscopy. (auth)

24453 ALLUVIAL AND MINERALOGICAL SURVEY CARRIED OUT IN CALABRIA, SOUTHERN ITALY, FOR THORIUM AND ZIRCONIUM ORES PROSPECTING. Preliminary Studies for Researches of Conventional Minerals with Alluvial Mineralogical Method. Brondi, A.; Ferretti, O.; Anselmi, B.; Benvegnu, F. (CNEN, Casaccia, Italy). Ind. Miner.; 23: No. 2, 51-67(1972). (In Italian).

A mineralogic prospection on alluvial sediments, first started after the discovery of several radioactive anomalies related to monazite and zircon concentrations in pegmatites in the valley of the river Crati, has been extended in the Calabria region, southern Italy. The aim of this research was to recognize possible detrital concentrations of both minerals in recent and ancient sedimentary formations originated from the erosion of rocks containing the minerals. The occurrences of zircon and monazite identified in Calabria are generally modest and have no economic interest. The total amount of zircon and monazite is very high but unfortunately both these minerals are dispersed in rock formations or in small scattered concentrations. Beside these researches, preliminary investigations have been started in order to verify the possibility in applying the mineralogical alluvial prospecting method in survey for conventional minerals. (INIS)

24454 URANIUM-BEARING CARPATHIAN REGION ROCKS AT THE LEVEL OF CLARKS. Gerasimov, Yu. G.; Latish, I. K. (Inst. of Geochemistry and Mineral Physics, Kiev). Dopov. Akad. Nauk Ukr. RSR, Ser. B; No. 6, 489-490(Jun 1973). (In Ukrainian).

New data are reported on uranium-bearing Carpathian rocks at the level of clarks. The data presented are of the considerable value in geochemical search for radioelements. (auth)

24455 URANIUM MINERALIZATION IN THE WEATHERED BEDROCK UNDER CAMBRIAN SANDSTONE AT KALMARSUND. Svensson, U. Geol. Foren. Stockholm Forh.; 95: No. 552, vp (31 Mar 1973). (In Swedish).

In 1957 a radioactive mineralization was found just north of the village Mönsterås on the east coast of southern Sweden opposite the island of Öland. There the bedrock consists of Pre-Cambrian granite and porphyry covered by Cambrian sandstone. The radioactive minerals are situated in the weathered layer under the sandstone and they consist of black coal-rich fragments assumed to be thucholite. In the same area breccia with galena, fluorite and calcite is found. As the contents of lead in the thucholite bearing arkose is high too we suppose that there exists a genetical relationship between the two types of mineralization. At another place more to the south, similar mineralizations were found and from earlier deep borings at Öland natural gas with helium and graphitic fragments in the quartzite under the Cambrian sandstones have been described. (auth)

24456 METHOD OF EXPRESSING RADIOGEOCHEMICAL CHARACTERISTICS OF MAGMATIC ROCKS BY A SINGLE SYSTEM OF COORDINATES AND ITS GEOCHEMICAL APPLICATIONS. Ermolaev, N. P.; Sobornov, O. P. (Inst. of Geochemistry and Analytical Chemistry, Moscow). Geokhimiya; No. 6, 803-815 (Jun 1973). (In Russian).

The distribution of K, U, and Th as well as the Th/U in the main petrochemical types of igneous rocks are considered. A. N. Zavaritsky's system of coordinates in the parameters "a" and "Q" is suggested for the generalization of radiogeochemical information in isolines. According to data of the radiogeochemistry of rocks a region of these parameters variations is singled out, and the compositions of magmas at the final stage of crystallization differentiation are characterized. A key is proposed for the solution of reconstruction of the petrochemical type of the rock according to concentrations of radioelements in it. (auth)

24457 TWO TYPES OF SORPTION ACCUMULATION OF URANIUM IN SEDIMENTARY ROCKS. Gavshin, V. M.; Bobrov, V. A.; Pyalling, A. O.; Reznikov, N. V. (Inst. of Geology and Geophysics, Novosibirsk, USSR). Geokhimiya; No. 6, 887-896(Jun 1973). (In Russian).

Sedimentary strata contain the well known uranium-containing phosphates and uranium-bearing laminated aluminosilicates (mainly hydromicas and chlorites). The apatite structure firmly retains uranium and products of its decay; therefore phosphate-bearing rocks display faint emanation and slight deviations from the state of radioactive equilibrium between uranium and radium. Uranium cannot be leached easily from phosphates by aqueous solutions, therefore there are no uranium minerals in phosphate-bearing rocks. Laminated aluminosilicates are on the contrary characterized by an intensive emanation and sharp deviations from the state of radioactive equilibrium between uranium and vanadium. Ura-

nium easily passes from them into aqueous solutions; consequently rocks with uranium-bearing hydromicas and chlorite minerals of the uranyl ion arise (under oxidizing conditions) and the so-called primary uranium minerals (in a reducing medium). (auth)

Radioactive Effluents

Refer also to abstracts 24461, 24482, and 26938.

24458 POLLUTION, AGGRESION, AND RADIOPROTECTION. Marble, G. (Societe Francaise de Radioprotection, Montrouge, France). Radioprotection; 7: No. 4, 197-205(1972). (In French).

The various sources of environmental pollution are discussed: radioactive pollution, chemical pollution, physical pollution, and biological pollution. The methods utilized in radiological protection for surveying the environment are presented and compared with the methods used to combat other forms of pollution. (FR)

24459 EVALUATION OF GROUNDWATER RECHARGE IN SEMI-ARID REGION OF INDIA USING ENVIRONMENTAL TRITIUM. Sukhija, B. S.; Rama, F. A. S. (Tata Inst. of Fundamental Research, Bombay). Proc. Indian Acad. Sci., Sect. A; 77: No. 6, 279-292(Jun 1973).

Depth variations of environmental tritium and of soil moisture in the unsaturated zone of the semi-arid alluvial tracts of northern Gujarat (India) are measured and utilised to evaluate vertical groundwater recharge. Results obtained from the two different experiments carried out at an interval of two years are found to be in fair agreement. An average of recharge amounting to about 5 per cent is indicated. The observed depth variation of tritium gives support to the view that the movement of soil moisture in this region is layered. (auth)

Radioactivity Monitoring and Transport

Refer also to abstracts 24698 and 24738.

24460 (AAEC/E-272) PROCEEDINGS OF THE AAEC SYMPOSIUM ON ENVIRONMENTAL AND RADIOLOGICAL SAFETY ASPECTS OF THE MINING AND PROCESSING OF URANIUM, LUCAS HEIGHTS, December 9–10, 1971. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Apr 1973. 111p. (CONF-711227-).

Separate abstracts were prepared for nine papers presented at this symposium. Summaries of 3 additional papers are included in the proceedings. (CH)

For abstracts of individual papers see: 24461, 24473–24476, 24482, 24763, 24851, and 24852.

24461 (AAEC/E-272, pp VII.1-VII.20, Paper VII) RADIOLOGICAL HEALTH AND SAFETY ASPECTS OF URANIUM MINING AND ORE TREATMENT. A Bibliography. Button, J. C. E. (comp.). Apr 1973.

From AAEC symposium on environmental and radiological safety aspects of the mining and processing of uranium; Lucas Heights, Australia (9 Dec 1971).

Two hundred and three references are arranged alphabetically by author under the headings environmental problems, external radiation measurement, general radiological health and safety aspects, historical aspects, internal contamination hazards, internal contamination measurement, internal contamination protection, medical aspects, monitoring programs, radioactivity fundamentals, radiological exposure limits, standards and regulations, ventilation, and waste management. (AT)

24462 (FOA-4-4549-A-1) ANALYSES OF FRESH RADIOACTIVE DEBRIS FROM THE CHINESE NUCLEAR TESTS OF DECEMBER 27, 1968; September 29, 1969; and OCTOBER 14, 1970. Bernstroem, B. (Forsvarets Forskningsanstalt, Stockholm (Sweden)). Aug 1973. 24p. Dep. NTIS (U. S. Sales Only) $3.25.

Radioactive debris from the Chinese nuclear tests of December 27, 1968, September 29, 1969, and October 14, 1970 was analyzed radiochemically with the object of determining the mass-distribution of the fission products. The results together with γ-spectrometric results of unprocessed samples are shown in tables and diagram. The obtained mass yields show a similar distribution as those reported by Harley et al for typical megaton weapons. The shielded nuclide cesium-136 is determined in two cases. The ratio $n,\gamma/n,f$ is found to be about 0.3 for these devices. (auth)

24463 (NP-19836) MONITORING OF RADIOACTIVITY IN 1972. (France). [nd]. 73p. (In French). Dep. NTIS (U. S. Sales Only) $5.75.

Data are presented from measurements of the total β and γ activity and content of certain radionuclides found in fallout in samples of air, soil, and milk collected at various locations throughout Western South America and the South Pacific Ocean during 1972. Data are included on ^{131}I, ^{90}Sr, ^{137}Cs, ^{144}Ce, ^{103}Ru, ^{95}Zr, ^{95}Nb, ^{141}Ce, ^{140}Ba, and ^{140}La. (CH)

24464 (NVO-410-11) ENVIRONMENTAL SURVEILLANCE SAMPLING RESULTS AT THE NEVADA TEST SITE, JULY 1969 THROUGH JUNE 1970. Brady, D. N. (comp.) (Reynolds Electrical and Engineering Co., Inc., Mercury, Nev. Environmental Sciences Dept.). Apr 1972. Contract AT(26-1)-410. 58p. Dep. NTIS $5.45.

Data derived from the environmental surveillance program at the Nevada Test Site (NTS) for fiscal year 1970 are presented. Gross beta radioactivity results for water and air samples collected throughout the NTS are listed and measurements of gamma radioactivity in soil and vegetation samples are also documented. Tabular data is supplemented by graphical presentations and sampling locations are shown in maps depicting the NTS. (auth)

24465 (NVO-410-15) ENVIRONMENTAL RADIOACTIVITY AT THE NEVADA TEST SITE, JULY 1966–JUNE 1967. (Reynolds Electrical and Engineering Co., Inc., Las Vegas, Nev. (USA)). May 1968. Contract AT(26-1)-410. 70p. Dep. NTIS $5.45.

This report contains a summary of the data obtained concerning the radiological conditions in the environment of the Nevada Test Site (NTS) from July 1966 through June 1967. The Environmental Surveillance Group performed routine and special surveys of the NTS. Samples of air and water were collected for laboratory analysis from living quarters, administrative buildings, and cafeterias. Additionally, samples of water from waste ponds, sewage basins, reservoirs, springs, and wells were collected on a routine basis to determine normal levels of radioactivity or any change of radioactivity. Air samples were also routinely collected at selected locations throughout NTS for the same purpose as for water samples. All environmental samples were analyzed routinely for gross alpha, beta, and gamma radioactivity. Significant increases or changes in the radioactivity levels of these samples were reported to the appropriate field monitoring groups for investigation and remedial action. All samples were documented by the Environmental Surveillance Branch for record purposes and for comparison with previous results to determine trend and correlation where feasible. (auth)

24466 (NVO-410-16) ENVIRONMENTAL SURVEILLANCE SAMPLING RESULTS AT THE NEVADA TEST SITE, JULY 1968–JUNE 1969. (Reynolds Electrical and Engineering Co., Inc., Las Vegas, Nev. (USA)). Oct 1971. Contract AT(26-1)-410. 64p. Dep. NTIS $5.45.

This report summarizes the data obtained from periodic environmental surveys at the Nevada Test Site (NTS) from July 1968 through June 1969. The Environmental Surveillance group performed routine and special surveys of the NTS. Samples of potable water were collected for laboratory analysis from living quarters, administrative facilities, and cafeterias. Additionally, samples of water from waste ponds, sewage basins, reservoirs, springs, and wells were collected on a routine basis to determine ambient levels of radioactivity or any changes of radioactivity. Air samples were also routinely collected at selected locations throughout NTS for the same purpose as for water samples. Soil and vegetation samples were collected to provide information for assessing trends in the distribution of fallout radioactivity levels. All environmental samples, except soil and vegetation, were analyzed routinely for gross beta radioactivity, and selected samples were additionally analyzed for plutonium alpha activity. Soil and vegetation samples were routinely analyzed for gross gamma radioactivity. Significant increases or changes in the radioactivity levels of these samples were reported to the appropriate field monitoring groups for investigation and remedial action. All sample results are permanently maintained by the Environmental Surveillance group for record purposes and for comparison with previous results to determine trends and correlations where feasible. (auth)

24467 (ORNL-4894) APPLIED HEALTH PHYSICS AND SAFETY ANNUAL REPORT FOR 1972. (Oak Ridge National Lab., Tenn.). Sep 1973. Contract W-7405-eng-26. 56p. Dep. NTIS $5.45.

Results of radiation monitoring of personnel and the environment of ORNL during 1972 are reported. There were no external or internal exposures to personnel that exceeded the standards for radiation protection as defined in AEC Manual Chapter 0524. There were no accidental releases of gaseous or liquid waste

from the Laboratory that were of a level that required an incident report to the AEC. Eleven unusual occurrences involving radioactive materials were recorded during 1972. The safety record for 1972 was good as compared with industry standards but was poor by comparison with ORNL's recent past performance. (CH)

24468 (SCPRI(RM)-4-1973) REPORT OF ACTIVITY, APRIL 1973. (Service Central de Protection Contre les Rayonnements Ionisants, Le Vesinet (France)). 1973. 12p. (In French). Dep. NTIS (U. S. Sales Only) $3.00.

This monthly report of the SCPRI gives an interpretation of the principal results concerning the surveillance of radioactivity in the environment: atmospheric dusts (air at ground level, high altitude air), rainwater, surface water, underground water, irrigation water, drinking water, food chain (milk, plants, cattle, fish), sea water around nuclear plant sites and other sites. The activities of various radioisotopes are presented in tables (^{7}Be, ^{95}Zr and ^{95}Nb, ^{103}Ru, ^{131}I, ^{137}Cs, ^{140}Ba and ^{140}La, ^{90}Sr, ^{106}Ru and ^{106}Rh, ^{226}Ra, ^{54}Mn, U and T). A monthly bibliographic selection is also presented. (Fr)

24469 (SCPRI(RM)-4-1973(Suppl.)) ANNEX TO MONTHLY REPORT, APRIL 1973. Detail of Results of Measurement. (Service Central de Protection Contre les Rayonnements Ionisants, le Vesinet (France)). 1973. 21p. (In French). Dep. NTIS (U. S. Sales Only) $3.25.

Measurement tables concerning the surveillance of the environment in France during August 1972 are presented. (CH)

24470 (UCLA-12-919, pp 43-51) NUTRIENT AND RADIONUCLIDE CYCLING. 1973.

In annual progress report for the period ending June 30, 1973.

Results from the chemical and physical characterization of soil profiles at 79 study sites located in some northern Mojave Desert areas of the Nevada Test Site are reported. The profiles were characterized under clumps of perennial vegetation and under bare desert pavement in order to determine the modifying influence of shrubs on desert soil. Concentrations of ^{137}Cs, ^{40}K, uranium, and thorium were determined in surface fractions of the soil profile. The following research projects were also conducted; correlations between soil characteristics and plant ecology in the Mojave desert; effect of shrubs on native fertility of the Mojave desert; sodium relations in desert plants; effects of NaCl on Tamarix ramosissima grown in solution; effects of chelated and nonchelated cobalt and copper on yields and microelement composition of bush beans grown on calcareous soil in a glasshouse; phosphorus levels vs. concentrations of zinc and other elements in bush bean plants; and response of bush bean plants to tin applied to soil and to solution culture. (HLW)

24471 (USGS-474-167) SUMMARY OF CHEMICAL AND RADIOCHEMICAL MONITORING OF WATER FOR THE CANNIKIN EVENT, AMCHITKA ISLAND, ALASKA, FISCAL YEAR 1972. Amchitka-38. Schroder, L. J.; Ballance, W. C. (Geological Survey, Lakewood, Colo. (USA)). Aug 1973. Contract AT(29-2)-474. 45p. Dep. NTIS $4.25.

An increased dissolved-solids content was found immediately after the Cannikin event (November 6, 1971) at most of 10 locations in a water-sampling network established in 1967 and revised in September 1971. The observed dissolved-solids content increase was within the seasonal range that has been observed at these locations. No measurable increase in radioactivity was detected as a result of the Cannikin event at the 72 locations monitored during fiscal year 1972. A measurable increase in gross beta/gamma activity was found in January 1972 which was correlated to a surface test of a nuclear device by a foreign nation. (auth)

24472 (DOCKET-50201-143) WEST VALLEY REPROCESSING PLANT. Quarterly Report for April 1, 1973-June 30, 1973. (Nuclear Fuel Services, Inc., West Valley, N. Y.). 17 Jul 1973. 9p. Dep. NTIS $3.00.

The environmental monitoring report for April 1, 1973 to June 30, 1973 for the West Valley Reprocessing plant is presented. Values are tabulated for: gross α, gross β, T, ^{90}Sr, and ^{129}I in liquid effluents; ^{131}I in gaseous effluents, ^{131}I in milk; perimeter monitoring of α and β; and removal factors for ^{137}Cs^{90}Sr, ^{106}Ru ^{106}Rh, and gross β by low level liquid waste treatment plant. (DHM)

Atmosphere

Refer also to abstracts 24172 and 24775.

24473 (AAEC/E-272, pp IX.1-IX.4, Paper IX) HISTORY OF RADIATION EFFECTS AND CONTROL IN URANIUM MINING. Watson, G. M. Apr 1973.

From AAEC symposium on environmental and radiological safety aspects of the mining and processing of uranium; Lucas Heights, Australia (9 Dec 1971).

A brief account is given of the hazards of environmental exposure for uranium miners, with particular reference to radon daughters, and to the incidence of radiation-induced lung cancer in miners. (AT)

24474 (AAEC/E-272, pp X.1-X.6, Paper X) URANIUM MINING: THE NATURE OF THE DOSIMETRY PROBLEM. Cook, J. E. Apr 1973.

From AAEC symposium on environmental and radiological safety aspects of the mining and processing of uranium; Lucas Heights, Australia (9 Dec 1971).

Assessment of radiological hazards to uranium miners is considered from different exposure routes: decay products of natural uranium; uranium and decay products in mine dusts; and radon daughters diffusing into the atmosphere from ores. (AT)

24475 (AAEC/E-272, pp XI.1-XI.9, Paper XI) PRACTICAL DOSIMETRY IN URANIUM MINING. Davy, D. R.; Conway, N. Apr 1973.

From AAEC symposium on environmental and radiological safety aspects of the mining and processing of uranium; Lucas Heights, Australia (9 Dec 1971).

A brief consideration is given to methods used for personnel monitoring in uranium ore precessing plants. Methods discussed include gamma surveys; personnel dosimetry; whole-body gamma counting; monitoring surface β contamination; monitoring inhalation of U/Ra; monitoring radon daughters (Kusnetz-method, Tsivoglou method, least squares regression analysis method, two filter method, and personnel monitors); monitoring unattached RaA; measurement of ingestion of ^{226}Ra; and sample preparation for radiometric analysis. (AT)

24476 (AAEC/E-272, pp XII.1-XII.9, Paper XII) PROSPECTS FOR CONTROL OF RADIOLOGICAL HAZARDS IN URANIUM MINING. Davy, D. R. Apr 1973.

From AAEC symposium on environmental and radiological safety aspects of the mining and processing of uranium; Lucas Heights, Australia (9 Dec 1971).

Aspects of environmental contaminants in uranium mine air considered are emanation of radon, the effect of ventilation, mine seepage water, open cut characteristics, and levels of external radiation exposure. (AT)

24477 (COO-3382-13, pp 8) DEVELOPMENT OF INSTRUMENTATION FOR THE MEASUREMENT OF ENVIRONMENTAL LEVELS OF RADON. [nd].

Radioactivity studies.

The instrument collects the positively charged radium-A daughter of radon and disintegrations are recorded with a phototube and scaler. The sensitivity is such as to measure 24-hr average concentrations of radon at a tenth of a picocurie per liter within ±10%. (MCG)

24478 (NDRE-60) STEADY STATE AEROSOLS. Storeboe, P. B. (Forsvarets Forskningsinstitutt, Kjeller (Norway)). Feb 1972. 104p. Dep. NTIS (U. S. Sales Only) $7.25.

In the search for causal relationship between aerosol formation parameters and aerosol characteristics, calculations on models are presented. Formation parameters treated are supply mass, mode and spread, dilution with pure air, and particle removal. Coagulation within the aerosol is treated as a continuous phenomenon concerning all particle size combinations present. The effect is a sort of inverse relationship between distribution density of particles at medium/large and at small sizes. A number of resulting size distributions are shown. Aerosols are classified in two groups. Aerosols with slow coagulation have low mass and contain either few particles or have a narrow size distribution, preferably at small sizes. Aerosols with faster coagulation display a distinct medium size particle mode, and they have few small particles. The distribution of individual elements of natural radioactivity in the aerosol is also studied. Simple aerosol age estimates based on radioactivity measurements are shown to be questionable. (auth)

24479 BEHAVIOR OF RADIOSTRONTIUM IN RAIN AND AIR AFTER THE NINTH CHINESE ATMOSPHERIC NUCLEAR TEST. Noyce, J. R.; Moore, D. T.; Beck, J. N.; Kuroda, P. K. (Department of Chemistry, University of Arkansas, Fayetteville, Arkansas, 72701). J. Geophys. Res. 78: No. 9, 1419-1426 (20 Mar 1973).

Strontium 89 and 90 were measured in rain water and air at Fayetteville, Arkansas (36°N, 94 °W), for 9 months after the ninth Chinese atmospheric nuclear test. The ^{89}Sr/^{90}Sr activity ratios showed behavior very similar to the pattern of variation observed after the eighth Chinese atmospheric test. Ratios of ^{89}Sr and ^{90}Sr activity in rains

to activity in air samples were computed, and these scavenging ratios were found to vary widely, but those for ^{89}Sr tended to be higher than those for ^{90}Sr. These ratios did not have a well-defined relationship with time, amount of rainfall, or a number of meteorological parameters. The data, however, indicate that a consistent relationship between fallout and rainfall may be necessary for scavenging ratios to be meaningful and useful on a short-term basis. This relationship apparently does not exist in areas of high cumulative deposition of ^{90}Sr, such as Fayetteville. (auth)

24480 RESERVOIR MODELS AND PRODUCTION RATE VARIATIONS OF NATURAL RADIOCARBON. Houtermans, J. C.; Suess, H. E. (Department of Chemistry, University of California, La Jolla, California, 92037); Oeschger, H. J. Geophys. Res. 78: No. 12, 1897-1908 (20 Apr 1973).

Distribution and time constants of the exchangeable carbon on the earth's surface are discussed in terms of a two-box model and a three-box model. Emphasis is given to the question of the functional relationship of the ^{14}C level in the atmospheric CO_2 to the cosmic ray production rate Q. It is shown in a quantitative way that relatively slow changes (with a time constant of more than 30 years) of the atmospheric ^{14}C content can be described adequately by a two-box model. More rapid changes require more complicated models. The most appropriate definition of 'residence time' of ^{14}C (and CO_2) in the atmosphere depends on the time scale of the phenomenon under consideration. The observed fluctuations of the ^{14}C content of atmospheric CO_2 during the past 7000 years can be explained by assuming production rate variations due to geomagnetic and heliomagnetic modulations of the cosmic ray flux, as long as these fluctuations occur on a time scale longer than $\approx$100 years. More rapid fluctuations with amplitudes in excess of 1%, if they exist, will require a different explanation. (auth)

Soil

Refer also to abstract 24634.

Water

24481 INFLUENCE OF RAIN AND OF DUSTINESS ON THE CONCENTRATION ^{90}Sr IN DIFFERENT RESERVOIRS. Kwapulinski, J.; Danecka-Palasz, R. Acta Geophys. Pol.; 21: No. 2, 139-151(1973). (In Polish).

The radioactivity and ^{90}Sr concentration in water of the limnic and reolimnic reservoir were studied. The following factors were found to influence the ^{90}Sr concentration in the water: the quantity of rain, the amount of dust, the relation of depth—h to surface—S, the surface—S, and the species of reservoir. The radioactivity and the ^{90}Sr concentration in the limnic reservoir increases quicker with an increase in depth than that of the reolimnic reservoir. A correlation was found between parameters and used to describe the equilibrium of regression $y = ax + b$. The highest radioactivity was always observed in the limnic reservoir. The reservoir indicated that the lower the relation h/S, the higher the gradient of concentration ^{90}Sr. (auth)

Ecosystems and Food Cycles

Refer also to abstracts 24487, 24851, 24861, and 26922.

24482 (AAEC/E-272, pp IV.1-IV.23, Paper IV) ENVIRONMENTAL STUDIES FOR URANIUM PROVINCES: AIMS AND METHODS. Davy, D. R. Apr 1973.

From AAEC symposium on environmental and radiological safety aspects of the mining and processing of uranium; Lucas Heights, Australia (9 Dec 1971).

Aspects related to environmental considerations involved in the exploitation of uranium mineral reserves are discussed with particular reference to the Northern Territory uranium province. Technological design criteria for discharge and potential pollutants are briefly considered. An assessment of an area involves characterization of the environment, determination of the ecological significance of habitats influenced by mining operations, measurement of the tolerance of significant habitats to pollution from different sources, and consideration of exposure routes to man of radioactive and chemical pollutants. (AT)

24483 (AECL-4421) OCCURRENCE, RADIOACTIVITY, AND DIVERSITY, OF WINNIPEG RIVER BENTHIC ORGANISMS IN THE VICINITY OF WHITESHELL NUCLEAR RESEARCH ESTABLISHMENT. Ireland, R. E.; Guthrie, J. E.; Robinson, A. G. (Atomic Energy of Canada Ltd., Pinawa (Manitoba). Whiteshell Nuclear Research Establishment). Jul 1973. 108p. Dep. NTIS (U. S. Sales Only) $7.50. AECL $2.00.

The abundance and total beta activity of the benthic insects in the Winnipeg River adjacent to the Whiteshell Nuclear Research Establishment (WNRE) were determined during 1966 and 1967. During the study, potential indicator species were identified and a number of aquatic insect species, not previously reported in Manitoba, were collected. Tubificid worms, Chironomidae larvae, and Hexagenia spp. naiads were the most abundant species in the total of 20 benthic taxa collected. The radioactivity concentration ratios (total beta activity of organism/total beta activity of water) of these species was $\simeq$2; therefore, any of them could serve as indicators of change in the level of radioactivities in the aquatic biota upstream and downstream of the WNRE liquid effluent outfall. Benthic-community diversity indices developed from information theory are finding increasing application as a method of assessing water quality. The range of individual diversity indices ($\bar{d}$) obtained in this study was 2.45 to 2.94, suggesting that the section of the river beside WNRE is mesotrophic. The information obtained will serve as a baseline with which to compare any future changes in the benthic communities of the river. (auth)

24484 STRONTIUM-90 IN THE BONE OF DIFFERENT SOUTH AFRICAN POPULATION GROUPS. Van As, D.; Fourie, H. O. (Atomic Energy Board, Pelindaba, S. Afr.). S. Afr. Med. J.; 45: No. 25, 694-696(1971).

Bone samples of different race and age groups were measured for ^{90}Sr content. In the 5- to 20-yr age group, significant differences were found between population groups. During 1966 to 1969, the ^{90}Sr content of milk, bread, and maize was also measured. The two chief population groups, Whites and Bantu, have very different dietary habits and consequently quite different Ca intakes and sources of ^{90}Sr in their diets. Dieting surveys were used for calculating Ca and ^{90}Sr intakes. An inverse relationship was found between the dietary Ca intake and the ^{90}Sr content of bone. (HLW)

Radiometric Techniques

Refer also to abstracts 24636—24638.

24485 (KFK-1771) THEORETICAL AND EXPERIMENTAL INVESTIGATIONS OF ORE DEPOSITS BY NEUTRON INDUCED GAMMA RADIATION. Wuerz, H.; Buth, L. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Neutronenphysik und Reaktortechnik). May 1973. 66p. (In German). Dep. NTIS (U. S. Sales Only) $5.50.

Some theoretical problems arising from the application of neutron-induced γ rays in the field of in-situ exploration of natural minerals are investigated. The exploration of borehole deposits is demonstrated for tungstenium deposits near Mittersill and for manganese nodules in the sea. The measured intensity of characteristic γ lines is related to the mineral concentration. Therefore the γ intensity is calculated as a function of the matrix. The unknown concentration can then be determined by comparison of the calculated calibration curve with the measured γ intensity. The influence of the matrix composition on the thermal and the epithermal neutron flux has to be investigated. The neutronic calculations are done by assuming that the materials are homogeneously distributed. Two cases are considered, the dry and the moderating borehole. In the moderating borehole a high γ intensity and therefore a good detection sensitivity is achieved. Conversely the thermal and the epithermal neutron flux are unambiguously dependent on the matrix composition only in the dry borehole. (auth)

24486 TRITIUM IN THE NATURAL WATER CYCLE. Jouzel, J.; Merlivat, L. (CEN de Saclay, Gif-sur-Yvette, France). Bull. Inform. Sci. Tech. (Paris); No. 178, 55-57(Feb 1973). (In French).

Tritium is introduced into the upper atmosphere during thermonuclear tests; in the form of oxidized HTO it participates at extremely low concentrations in the different stages of the natural water cycle. Its introduction at a precisely defined time makes it a useful tracer for use in meteorology, glaciology, hydrology, and oceanography. (FR)

24487 USE OF RADIOACTIVE ISOTOPES TO MEASURE THE TRANSFER OF MATERIALS IN AQUATIC FOOD CHAINS. Conover, R. J.; Francis, V. (Fisheries Research Board of Canada, Dartmouth, Nova Scotia). Mar. Biol.; 18: No. 4, 272-283(1973).

Radioisotopes were used extensively in transfer studies within food chains. Unless it is known that no recycling of isotope has occurred during the experiment, the assumption of linear uptake when in fact the system is not linear, even over short periods, can lead to significant errors in the estimation of ingestion or feeding. If recycling occurs, at least a 3- or 4-compartment, hydraulic-type model is necessary to even approximate the complicated kinetics of isotopic transfer in a simple aquatic feeding experiment. In any event, it is essential to follow the uptake or loss of an isotope as a function of time in at least one compartment before deciding on

an appropriate model. If experiments are designed so that the maximum number of rate processes are summed or integrated by the animals, the kinetics can be considerably simplified. If the food supply is uniformly labelled, the rate of change of tracer can be used to give a rate of ingestion. If the predator is labelled with a suitable isotope before starting the experiment, the rate of loss of its isotope burden under different experimental conditions can be used to determine respiration or excretion rates, turnover rates, ingestion, and the size and number of major compartments in the transfer system. (GE)

24488 Rb–Sr DATING AND MICROCLINIZATION IN DIORITIC ROCKS OF THE HAPARANDE GROUP, NORTHERN SWEDEN. Brotzen, O. (Sveriges Geologiska Undersoekning, Stockholm). Geol. Foren. Stockholm Forh.; 95: No. 552, 19-24(31 Mar 1973).

Recent Rb–Sr data on the Haparanda plutonites, Northern Sweden, are discussed in relation to field evidence of post-intrusion microclinization. It is concluded that the plutonites did not remain closed systems after emplacement and that the whole-rock data represent mixed ages, whereas the biotide data may record the time of microclinization. The minimum age of primary crystallization is 2.25 to 0.10×10^9 y and the maximum time since the resetting of biotite is $1.85 + 0.035 \times 10^9$ y. The microcline data are anomalous. Routine statistical treatment of such Rb–Sr data does not yield the ages of primary intrusion. Criteria for the recognition of rejuvenation in the Rb–Sr data are discussed, and geological comparisons with other areas in Sweden and Finland are made. (auth)

24489 INVESTIGATION OF RECHARGE TO THE NORTHERN ADELAIDE PLAINS AQUIFERS USING ENVIRONMENTAL TRITIUM. Allison, G. B.; Holmes, J. W.; Hughes, M. W. J. Geol. Soc. Aust.; 19: No. 4, 497-500(Jan 1973).

Recharge to the Quaternary aquifers beneath the Northern Adelaide Plains was estimated to be 3.9×10^6 m^3/y using the environmental tritium concentration of water samples taken from suitably sited boreholes. Recharge to the Tertiary aquifers was estimated to be 0.4×10^6 m^3/y, by the same isotopic techniques. These results may be compared with a total recharge by leakage through the beds of streams that cross the plain, estimated by the South Australian Department of Mines to be 6.4×10^6 m^3/y. (auth)

24490 APPLICATION OF THE SELECTIVE GAMMA-GAMMA METHOD IN WELL LOGGING. Morvai, L.; Viola, B. Magy. Geofiz.; 13: No. 3, 84-89(1972). (In Hungarian).

Small amounts of copper, iron, and lead were determined in boring well by selective gamma-gamma scattering. The energy distribution of the scattered rays gave information on the type of segmentation. Developing a special scintillation–detector system placed in the bore the decrease of the scattered intensity due to the photoeffect was registered. ^{75}Se and ^{241}Am source were used. Disturbing effects of the difference of density in ores were corrected by the variation of the length of the gauge. Quantitative interpretation of the results were given comparing with standard metal mixtures. (INIS)

24491 METHOD OF LOGGING A SUB-SURFACE FORMATION. Murphy, R. P. (to Amoco Production Co.). U. S. Patent 3,748,474. 24 Jul 1973. Filed date 27 Dec 1971. 10p.

This invention relates to determining the oil saturation in an underground rock reservoir by use of a log-inject-log-inject-log technique. Thermal neutron decay time logs are taken in the native state, after fresh water injection and again after an alcohol injection followed by formation type water. These logs are used in an equation to determine oil saturation without need of knowledge of porosity or thermal neutron capture cross section of the formation rock. (Official Gazette)

24492 CHANGES IN THE ISOTOPIC COMPOSITION OF EAST MEDITERRANEAN SEAWATER DURING THE HOLOCENE. Magaritz, M.; Kaufman, A. (Weizmann Inst. of Science, Rehovoth, Israel). Nature (London); 243: No. 5408, 462-464(22 Jun 1973).

It is stated that when molluscs secrete their shells the $\delta^{18}O$ in the shell is a function only of the temperature and the $\delta^{18}O$ in the water. Thus the temperature at which an ancient shell was formed can be computed by measuring its $\delta^{18}O$ value, assuming that of the water in which it grew. The present Eastern Mediterranean (EM) is more saline and has a higher $\delta^{18}O$ than the Western Mediterranean (WM), and consideration is here given as to whether this difference always existed and, if not, when it occurred. Measurements were made of the oxygen isotopic composition and ^{14}C ages of samples of the aragonite forming mollusc Glycimeris violacescens from several locations along the Israeli coast. Details are given of the analytical methods employed, hypotheses are advanced to explain the results obtained. It is concluded that, assuming that water temperatures in the EM have varied in the same way as in the WM, there has always been a 4°C difference between the EM and WM. Also, that the $\delta^{18}O$ has remained approximately at the present value for the past 2800 y, but that between 2800 and 4900 y ago there was a change in the EM water from 0.2 to 0.1‰. It is noted that the value of $\delta^{18}O$ calculated for EM water 4900 y ago is similar to that of the present WM (0.1‰). Consideration is given as to how these changes could have arisen. (UK)

24493 FIXATION OF MANGANESE ON QUARTZ, LIMESTONE, DOLOMITE, AND MARINE SEDIMENT SAMPLES. Picer, M.; Picer, N.; Strohal, P. (Inst. for Medical Research, Zagreb). Health Phys.; 25: No. 3, 285-290(Sep 1973).

Well-known radiotracer techniques were applied to sorption–desorption processes of manganese that were investigated in a seawater medium, in sea sediments, limestone, dolomite, and quartz. The influence of salinity and pH were also measured. Desorption processes were studied in relation to the changes of pH of the sea system. Sorption isotherms were studied in sea sediment, limestone, and quartz. The results indicate that under natural conditions in the sea environment the sorption of ^{54}Mn on marine sediment is relatively low. At lower pH values, which may be found in the guts of certain animals, strong desorption was found. (auth)

24494 SUBTRACTION TECHNIQUE OF THERMOLUMINESCENT DATING. Fleming, S. J.; Stoneham, D. (Oxford Univ.). Archaeometry; 15: No. 2, 229-238(Jul 1973).

An account is given of the subtraction technique of thermoluminescent dating of pottery, combining the routine "fine-grain" and "inclusion" techniques. The theory is given, and some necessary corrections are discussed. The effect of porosity on alpha radiation dosimetry is considered, and some limitations of the new method are defined. Several examples of the use of the method are presented. It is concluded that the subtraction technique has great potentialities in the dating of sites where no environmental information is available, but its accuracy (±12% for 1 standard deviation) is likely to limit its general use to archaeological and art historical problems that carry greater uncertainties still. It is suggested that material from Africa and the new sites of southeast Asia offer the most likely application. (UK)

24495 COMPARATIVE STUDY OF THE SPATIAL DISTRIBUTION OF URANIUM AND OF TL-PRODUCING MINERALS IN ARCHAEOLOGICAL MATERIALS. Malik, S. R.; Durrani, S. A.; Fremlin, J. H. (Univ. of Birmingham, Eng.). Archaeometry; 15: No. 2, 249-253(Jul 1973).

It has been shown that in many pottery shards a sizeable fraction of the thermoluminescence comes from rather large crystalline grains, and that these grains are far lower in alpha radioactivity than the clay matrix which surrounds them. In a new technique a "spark counter" has been used for replicating the spatial distribution of uranium in archaeological samples. The pattern of TL-producing minerals in the same samples, obtained by direct photography of γ-irradiated samples as they are heated, is then compared with the uranium distribution. It is concluded that a good indication is given as to whether significant errors would be made in the TL age if unseparated materials are used. (UK)

24496 CRUCIBLE CONTRIBUTION TO ATMOSPHERIC CONTAMINATION, IN CONNECTION WITH K–Ar DATING. Charlton, S. R.; Mussett, A. E. (Univ. of Liverpool). Chem. Geol.; 11: No. 4, 237-241(Jul 1973).

The gases released from a molybdenum crucible, as used in K–Ar dating, were measured dynamically using a mass spectrometer. Mass 28 was the principle component but the amount of ^{40}Ar ($\approx 5 \times 10^6$ cm^3/S.T.P. for a 4.5-g crucible) may be an important source of atmospheric contamination, and limit the precision of age determination in young, or low-potassium rocks. The amount of argon could be reduced by about two orders of magnitude by degassing the crucible; however, this improvement was reduced to one order if the degassed crucible was allowed to come in contact with the atmosphere. The heated glass sides of the fusion dome did not contribute a significant amount of gas. (auth)

24497 NEITRON–NEITRONNYI I NEITRONNYI GAMMA–METODY V RUDNOI GEOFIZIKE. (Neutron–Neutron and Neutron–Gamma Methods in Ore Geophysics). Filippov, E. M.; Vakhtin, B. S.; Novoselov, A. V. Novosibirsk, USSR; Izdatel'stvo Nauka Sibirskoe Otdelenie (1972). 347p.

Topics discussed include: basic principles of neutron interaction with matter, description of detectors, laboratory, field, and mine neutron–neutron and neutron–gamma methods, and methods of investigating boreholes. (DHM)

24498 SCHEME OF STATISTICAL UNIFICATION OF RADIOMETRIC WELL LOGGING AND ESTIMATION OF COMPACTNESS AND SHALYNESS INDICES. Frydecki, J. (Geological Inst., Warsaw). Acta Geophys. Pol.; 21: No. 2, 93-111(1973).

It was found that in the case of ascertained stability of the

radiometric properties of selected "level mark" layers, a linear transformation of the measurement scales into the selected standard scale is possible. Using the results of resistivity logging, gamma logging, and neutron-gamma logging, a regressional analysis was made. On the basis of the directional trends of regression, the method of estimating the compactness and shalyness indices, and the ratio of extremal neutron limestone porosities is introduced. (auth)

24499 RADIOINDIKATORNYE METODY ISSLEDOVANIYA DVIZHENIYA PODZEMNYKH VOD. (Radioindication Methods for Investigating the Motion of Subterranean Waters). Churaev, N. V.; Il'in, N. I. Moscow; Atomizdat (1973). 176p.

The theoretical bases for the use of radioactive indicators for the investigation of the processes of the transfer of moisture in porous medium and the motion of subterranean waters were examined. The precision of the radioindicator methods in hydrogeology and hydrotechnology was described and the results of their experimental verification were reported. A special section was devoted to the methods of carrying out field radioindicator measurements. A review is given of the present status of the use of radioindicator methods in hydrogeology and hydrotechnology. (tr-auth)

Site Surveys

Refer also to abstracts 24471, 24738, and 26944.

24500 (BNWL-CC-1296) ENVIRONMENTAL SIGNIFICANCE OF DIESEL FUEL ENTERING COLUMBIA RIVER AT 100-N. Selby, J. M. (Battelle Pacific Northwest Labs., Richland, Wash.). Aug 1967. Contract AT(45-1)-1830. 5p. Dep. NTIS $3.00.

Diesel fuel is entering the Columbia River at 100-N as a result of loss of fuel from a storage and transmission facility and subsequent passage through the soil. This report contains preliminary data and an initial evaluation of the problem associated with the loss of fuel to the river. Additional studies are suggested to provide more information for evaluating the pollution resulting from the oil leakage, assuming the problem continues. (auth)

24501 (NVO-520-1) AMCHITKA BIOENVIRONMENTAL PROGRAM. Research on the Sea Otter, Amchitka Island, Alaska. Final Report, 1 October 1970–31 December 1972. Estes, J. A.; Smith, N. S. (Arizona Cooperative Wildlife Research Unit, Tucson (USA)). Jun 1973. Contract AT(26-1)-520. 97p. Dep. NTIS $5.45.

Research on the sea otter population of Amchitka Island was conducted to study the animals' behavior, ecology and physiology, and evaluate and document effects of the Cannikin event. The study objectives included sea otter diving behavior, population estimates, natural and event related mortality, and benthic ecological interrelationships. Energy metabolism studies were conducted in cooperation with the Institute of Arctic Biology, University of Alaska. Effects of Cannikin were observed in the sea otter population occupying about 10 miles of coastline in the Bering Sea adjacent to ground zero (SGZ). Sea otter population numbers decreased noticeably in this localized area and patterns in natural mortality suggest a decrease in sea otter numbers in the above mentioned area following the event. Population studies conducted to estimate numbers of sea otters around Amchitka Island indicated more animals than were stated by earlier investigators. Information on the distribution and movement of these animals is reported. Studies on sea otter–benthic community interrelationships indicate that the presence of large sea otter populations has profound effects upon abundance, distribution, and size class structure of certain benthic invertebrates and plants. (auth)

24502 (USGS-474-168) SOME FACTORS RELEVANT TO THE DETERMINATION OF IN SITU STRESS BY ANALYSIS OF GEOLOGICAL AND GEOPHYSICAL DATA. NTS-247. Bucknam, R. C. (Geological Survey, Denver, Colo.). Sep 1973. Contract AT(29-2)-474. 25p. Dep. NTIS $4.00.

In the absence of direct (in situ) instrumental measurements of stress, analysis of available geological and geophysical data is an obvious alternative approach to evaluating the state of stress of an area. Stress components due to the gravitational load are commonly estimated by calculations based on physical properties of the rock section. The most common methods of estimating stress components due to tectonic processes are based on analysis of fault patterns, seismic first-motion data, characteristics of body waves and surface waves from explosions and earthquakes, and the pattern of natural and explosion-produced strain fields. However, an appraisal of these methods of inferring stress indicates that the level of uncertainty associated with the inferred stresses may be as large as the stress values themselves. In situations requiring accurate, reliable stress values, analysis of geological and geophysical data seem best suited for use in interpolating between points where stress has been measured by in situ methods or for providing a framework for interpreting measured stress data. (auth)

Thermal Effluents

Refer also to abstract 24698.

24503 (COO-2173-1) FIRST REPORT OF A STUDY TO FORECAST NUCLEAR POWER PLANT EFFECTS ON COASTAL ZONES. Ahn, C. S.; Smith, P. F. (EG and G, Waltham, Mass. (USA)). Dec 1972. Contract AT(11-1)-2173. 392p. GPO $3.70.

Modern oceanographic techniques were applied to the problem of understanding and to the problem of predicting the physical processes taking place in the marine coastal zone that are of importance in forecasting the effects of nuclear power plants using these waters for cooling. The techniques applicable to the forecasting problem itself; i.e., the methods of predictive modeling, were also investigated. The modern marine science technique included both data gathering and data handling aspects and so employed recently developed oceanographic instrumentation and the facilities of contemporary high-speed digital computers and associated peripheral equipment. Both the field methods and equipment for gathering information and the computer programs and routines for manipulating this information are described in detail. Four month-long data acquisition periods were carried out approximating the four seasons. Using this data, a description of coastal processes is made that include a discussion of the currents, the meso scale circulation, an analysis of ways of looking at recorded data by breaking it down into components (i.e., by frequency bands, by averaging concepts, or by direction) and a discussion of the role played in these coastal processes by meteorological effects. Predictive modeling of the interaction between the heated effluents of nuclear power plants and the observed coastal zone mechanisms is considered by both deterministic and phenomenological methods as well as by a combination of the two. The governing equations and major assumptions required to handle mathematically the physical processes of heated effluents are presented and thereby dispersion equations developed. The processes of dispersion and heat exchange at the sea surface are described and discussed as they relate to predictive modeling. Examples of the results obtained by applying the several approaches to forecasting nuclear power plant effects in an area with the coastal zone characteristics of the Gulf of Marine are presented. These results are themselves analyzed to show their sensitivity to input information and their applicability to worst case analysis. The problem of validation is also considered. The usefulness of the results of this work, the predictive models, and the data on coastal processes are reviewed both as regards biological matters and engineering design considerations from an ecological standpoint. Appendices contain a thorough documentation of the computer programs, data chronology, and potential application of Geomagnetic Eletrokinetograph (GEK). (CH)

24504 ANALYSIS OF THE INJECTION OF A HEATED, TURBULENT JET INTO A MOVING MAINSTREAM, WITH EMPHASIS ON A THERMAL DISCHARGE IN A WATERWAY. Campbell, J. F. Blacksburg, VA; Virginia Polytechnic Inst. (1972). 198p. University Microfilms Order No. 73-21,513.

Thesis (Ph. D.).

An experimental and theoretical investigation has been undertaken to study the trajectory and growth of thermal effluents having a range of discharge velocities and temperatures. The discharge of a turbulent effluent into a waterway was mathematically modeled as a submerged jet injection process by using an integral method which accounts for natural fluid mechanisms such as turbulence, entrainment, buoyancy, and heat transfer. The analytical results are supported by experimental data and demonstrate the usefulness of the theory for estimating the location and size of the effluent with respect to the discharge point. The capability of predicting jet flow properties, as well as two- and three-dimensional jet paths, was enhanced by obtaining the jet cross-sectional area during the solution of the conservation equations (a number of previous studies assume a specific growth for the area). Realistic estimates of temperature in the effluent were acquired by accounting for heat losses in the jet flow due to forced convection and to entrainment of free-stream fluid into the jet. (Diss. Abstr.)

Chemical Effluents

Refer also to abstracts 24458 and 26890.

24505 (ORNL-TM-4298) STUDY OF OPTIONS FOR CONTROL OF EMISSIONS FROM AN EXISTING COAL-FIRED ELECTRIC

POWER STATION. (Oak Ridge National Lab., Tenn.). Sep 1973. Contract W-7405-eng-26. 335p. Dep. NTIS $18.75.

Alternatives for the reduction of sulfur oxide emissions from an existing 1300-MW coal-fired electric power station are compared with respect to technological feasibility, practicality, and cost. The two principal options available for near-term (1975-1977) application are (1) low-sulfur fuel oil derived from petroleum, and (2) low-sulfur western coal. Low-sulfur fuel oil is technologically practicable now, but the long-term outlook is for continued scarcity, high price, and unreliability of supply. Low-sulfur coal has high transportation cost and may cause derating of plants designed for eastern U. S. bituminous coals. Stack gas treating processes such as scrubbing with limestone slurry do not yet have the degree of operating reliability needed for power plant use. It is estimated that processes for treating stack gas may achieve 90% reliability by about 1976, but implementation by 1977 would require selection of a process and initiation of engineering by about 1974-1975. Other options that may become available in the longer term are low-Btu gas, solvent refined coal, and liquid fuels produced from coal. Low-Btu gas has the advantage of a high degree of sulfur removal and the potential for future use in combined cycles of high efficiency. However, the gas must be produced close to the point of use because long distance transportation would be prohibitively expensive. Solvent refined coal appears to have considerable potential, assuming that planned pilot-plant operations are successful. Fuels produced by the liquefaction of coal have considerable promise not only for power plant use but also for easing the long-term shortage of liquid fuels needed for the transportation sector. (auth)

24506 COST EFFECTIVENESS OF EMISSION CONTROL. Babcock, L. R. Jr.; Nagda, N. L. (Univ. of Illinois, Chicago). J. Air Pollut. Contr. Ass.; 23: No. 3, 173-179(Mar 1973).

Steam electric power plants, gasoline motor vehicles, and industrial boilers have been identified as the major sources of air pollution (50% of the nationwide total). In general our study supports the Environmental Protection Agency (EPA) efforts toward control of these and other major stationary and mobile sources. Successful implementation of the EPA policies would reduce nationwide pollution damages by 1976 to roughly 56% of 1967 levels, with an attractive cost/benefit ratio of only 0.39. (auth)

INSTRUMENTATION

Radiation Detection Instruments

General Detectors and Monitors

Refer also to abstracts 24857, 25296, 25297, 26141, 26516, 26527, 26621, and 26673.

24507 (BARC/I-215) DEVICE FOR CRITICALITY MONITOR CALIBRATION. Janardhanan, S.; Dabhadkar, S. B.; Soman, S. D. (Bhabha Atomic Research Centre, Bombay (India)). 1972. 9p. INIS.

Salient features of a calibration device for a criticality monitor manufactured at the Bhabha Atomic Research Center, India are described. The detector essentially consists of an ion chamber which gives a current output proportional to the gamma incident dose. This output is then differentiated by a period amplifier which delivers a signal proportional to the rate of change of the gamma field on a meter which is in itself not responsive to very high static gamma fields. The main problem is the setting up of a reliable alarm limit, so that the instrument will give a positive alarm in a nuclear excursion and this is achieved by proper administrative control and reset only from the panel. A brief description of the design and procedure adopted is included. The tests for the calibration device as well as the calculations performed are outlined. (INIS)

24508 (BMFT-FBK-73-21) BASIC RESEARCH ON THE NOISE OF SEMICONDUCTOR COUNTER DIODES. Feight, I. (Siemens A. G., Erlangen (West Germany). Forschungslaboratorien). Aug 1973. 94p. (In German). Dep. NTIS (U. S. Sales Only) $6.75.

The problem of energy resolution in radiation measurement with semiconductor detectors is linked to a certain extent to the intrinsic noise generated by the detectors. Studies being conducted with the aim of obtaining general information on the origin and characteristics of noise in semiconductor diodes are discussed. Investigations have been made of frequency and surface and temperature functions of the noise, primarily on silicon components. It was found that, independent of the special nature of the silicon counting diodes measured, low-frequency noise is generally a surface or interface effect and has the character of a 1/f law. In the high-frequency range, the 1/f noise disappears in favor of a frequency-independent shot noise. Clear proportionality exists between the density of the surface states and low-frequency noise. Since the density and sign of the surface states not only influence noise, but also breakdown, certain requirements regarding the production of low-noise and high-voltage diodes are necessary. (GE)

24509 (CEA-R-4498) PROBLEMS OF GEOMETRY IN CONNECTION WITH EFFICIENCY CALCULATIONS IN IONIZING RADIATION METROLOGY. Becker, A.; Lame, J.; Vallee, M. (Commissariat A L'Energie Atomique, Saclay (France). Centre D'Etudes Nucleaires). Sep 1973. 56p. (In French). Dep. NTIS (U.S. Sales Only) $5.00.

The problems dealt with, chosen as typical examples, are as follows: calculation of the volumes scanned by beams limited by parallel coaxial emitter–receiver discs, the numerical precision obtainable allowing the case of the circular crown and consequently that of the excentric point source; considering the system with a medium interposed, it is possible to arrive at transmission factors (concentrating only on primary events of charged particles); for electromagnetic emissions of point origin inside a cone limited by proportional counter walls of semi-cylindrical geometry (including flat end), evaluation of the number of first interaction events and hence of detection efficiency; determination, by simulation, of the volume density of primary collisions of neutral particles in a homogeneous medium bounded by a cylinder; evaluation of energy transfers by charged particles of discrete or continuous energy spectrum (α, β, protons ...) emitted isotropically from point sources, uniformly distributed in a medium bounded by a sphere or a cylinder, extension to any other volume accessible to analysis being possible; from this can be known the energy spectrum absorbed in an extended homogeneous source of defined volume, whether the medium is gaseous, liquid or solid, and the emergent "complementary" spectrum. A model is thus established for the wall effect and a computed numerical answer found to the question of self-absorption in thick homogeneous circular sources. Some subroutines and a FORTRAN IV program have been set up in relation to the questions raised. (auth)

24510 (DP-1328) LOCATING END BOUNDARIES OF IRRADIATED ^{242}Pu TARGET CORES BY UNDERWATER DETECTION OF ^{252}Cf FAST NEUTRONS. Herold, T. R.; Ayres, W. F. (Du Pont De Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab). Aug 1973. Contract AT(07-2)-1. 20p. Dep. NTIS $4.00.

A method and instrument were developed to locate the end boundaries of irradiated ^{242}Pu target cores under water by detecting the spontaneous fission neutrons from irradiation-produced californium isotopes in the cores. The neutrons are detected in an air-filled collimator tube extending from near the core to the water surface. By this technique twenty-one targets were marked and cut under 4.5 m of water without releasing radioactive contaminants. A similar technique could be used to find and map neutron emitters in water or other neutron-moderating media. (auth)

24511 (ISS-72/7) NEW SOLID STATE DETECTOR TO MEASURE ENERGY AND POSITION OF CHARGED PARTICLES. Calicchia, A. (Istituto Superiore di Sanita, Rome (Italy). Laboratori di Fisica). 29 Apr 1972. 27p. (In Italian). Dep. NTIS (U. S. Sales Only) $3.50.

Position sensitive detectors are illustrated; they are solid state detectors that permit the detection of the energy and the point impact position of charged particles on the detector. After summing up the principles of operation and advantages as compared with other particle counters, measurements carried out on some of these new type detectors are discussed. (auth)

24512 (JPRS-59769, pp 1-18) APPLICATION OF SEMICONDUCTOR DETECTORS OF IONIZING RADIATION. Slapa, M. Translated from Postepy Fiz.; 23: No. 4, 429-444(1972).

Basic performance parameters of Ge and Si detectors are discussed, and various applications of semiconductor detectors are outlined including uses in nuclear physics and chemistry, nuclear spectroscopy, gamma and x-ray dosimetry, and uses in engineering devices in the nuclear industry. (WHK)

24513 (ORNL-TM-4346) COMPACT ELECTRONIC SYSTEM FOR AN IMPROVED ALPHA AIR MONITOR. Christian, D. J.; Thorngate, J. H. (Oak Ridge National Lab., Tenn.). Sep 1973. Contract W-7405-eng-26. 14p. Dep. NTIS $3.00.

An inexpensive, compact electronic system was built for use with a recently designed continuous alpha air monitor. The circuit produces three analog outputs, one of which is the ratio of the pulse rates from two alpha detectors while the others provide signals proportional to the pulse rates produced by the individual detectors. All three outputs can be used with strip-chart recorders. To decrease the total number of components, dual integrated circuits were used; one half for each input. Although designed for use with scintillation alpha counters, the system can be used with other types of detectors because integrating (charge sensitive) preamplifiers were used. The linearity and accuracy of the circuit make it suitable for other monitoring applications as well. (auth)

24514 (UCLA-12-919, pp 102-110) RADIATION MEASUREMENTS PROGRAM. 1973.

In annual progress report for the period ending June 30, 1973.

Topics include computerized x- or gamma-ray transmission tomography for brain scanning, computer algorithm for image reconstruction, high rate detection using CdTe of HgI_2 detector and associated time variant filter development, positron imaging, esophageal probe for measurement of plutonium in the tracheobronchial lymph nodes, high atomic number materials for radiation detectors, proton or heavy ion microprobe for biological use, basic studies of the characteristics of x-ray production and energy loss mechanisms of charged particle interaction, and high purity germanium detector fabrication and research. (WHK)

24515 $^{14}N(n,p)^{14}C$ REACTION IN NEUTRON BEAM STRENGTH AND OTHER REACTOR MEASUREMENTS. Bates, J. C. (Universities Research Reactor, Risley, Eng.). Nucl. Instrum. Methods; 111: No. 2, 205-208(1973).

Possibly because of the relatively low cross-section and Q-value the $^{14}N(n,p)^{14}C$ reaction seems to have been neglected in reactor measurements. This reaction has been found valuable at the Universities Reactor in mean current ionization chambers and proportional counters for measuring neutron beam strengths, locating optimum n/γ ratios and more general applications. (auth)

24516 MEASUREMENT OF THE SMALL-ANGLE SCATTERING OF FAST NEUTRONS. Bucher, W.; Hollandsworth, C.; Lamoreaux, R. (Army Ballistic Research Labs., Aberdeen Proving Ground, MD). Nucl. Instrum. Methods; 111: No. 2, 237-249 (1973).

The measurement of the small-angle scattering of 5- to 15-MeV neutrons from low-A nuclei requires an experimental technique of high sensitivity. In order to determine the most suitable technique, various scattering geometries are studied and compared. The experimental approach found optimum involves the use of an unusual scattering geometry for which a four-fold collimator-detector array with fixed collimating channels has been especially designed and constructed. The principles of measurements in this geometry are developed and discussed in detail. From performance tests with the collimator-detector array, the acceptances of the collimating channels and the overall experimental sensitivity are determined. Preliminary measurements are presented of the 7.55-MeV elastic cross section of O, Al, Fe, Sn, and Pb for neutron scattering in the angular range 2.5° to 15°. (auth)

24517 ORGANIC SCINTILLATOR NEUTRON DETECTOR EFFICIENCY: A COMPARISON OF EXPERIMENTAL RESULTS WITH PREDICTIONS. Plasek, R.; Miljanic, D.; Valkovic, V.; Liebert, R. B.; Phillips, G. C. (Rice Univ., Houston, TX). Nucl. Instrum. Methods; 111: No. 2, 251-252(1973).

Absolute efficiency points in the neutron energy range 2 to 10 MeV were taken for a 7.62 cm × 12.7 cm NE-218 liquid organic scintillator. These results were compared with the efficiency predictions of programs DETEFF and 05S. Only program DETEFF calculations were consistent with the experimental points obtained. (auth)

24518 Si(Li) POSITION SENSITIVE DETECTOR. Gigante, J. R. (Univ. of Maryland, College Park). Nucl. Instrum. Methods; 111: No. 2, 345-353(1973).

A position sensitive detector has been made using the lithium diffused layer of a lithium-drifted-silicon detector as the uniform resistive layer. An expression is derived for estimating the resistance from the thickness of the lithium layer. Expressions for the noise and ballistic deficit for single differentiation-double integration pulse shaping are presented. Room temperature data for a 1 MeV proton beam on a 45 mm long detector shows that the linearity is better than 0.05% and that the position resolution is 1.06 ± 0.5 mm. (auth)

24519 ELECTROSTATIC TOROIDAL ANALYZER FOR INVESTIGATIONS OF STREAMS OF CHARGED PARTICLES IN COSMIC SPACE. Volkov, G. I.; Zastenker, G. N.; Kopylov, V. F.; Pozdnov, Yu. N.; Remizov, A. P.; Khokhlov, M. Z. (Inst. of Space Research, Moscow). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 1, 43-45(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 1, 43-45(1973).

An instrument is described for studying streams of charged particles having energies of up to 30 keV. A toroidal deflection system having symmetrical angular characteristics serves as the electrostatic analyzer. The particle detector is a secondary-electron multiplier whose voltage is controlled by the output current; this ensures a large dynamic measurement range (up to 10^6) and a high sensitivity of the instrument (2×10^3 cm^{-2} · sec^{-1} · sr^{-1}). (auth)

24520 MEASURING THE LINEAR POLARIZATION OF COSMIC GAMMA QUANTA BY MEANS OF THE COMPTON EFFECT. Gal'per, A. M.; Miloserdin, V. Yu. (Moscow Engineering-Physics Inst.). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 1, 46-48(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 1, 45-48(1973).

The possibility of using the Compton effect for measuring the polarization of γ quanta is analyzed. The possible systematic measurement errors are investigated. A method is proposed for measuring the polarization of cosmic γ quanta having an energy 0.5 to 5 MeV. (auth)

24521 INCREASING THE SPEED OF RESPONSE OF A COUNTING CHANNEL WITH HALIDE GAMMA-QUANTUM AND BETA-PARTICLE COUNTERS. Shishmolin, A. N.; Kolesov, B. M.; Ganichev, G. I.; Kreknin, Yu. S.; Ovchinnikov, A. K.; Bobrovskii, V. P.; Podpoyaskin, V. A. Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 1, 69-70(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 1, 65-66(1973).

The dead time t_d and the recovery time t_r of SBM-10 halide G-M β-counters were determined. It was shown that t_d and t_r depend essentially on the time constant of the RC circuit of the counter. The quantities t_d and t_r, which are determined by the discharge mechanism in the counter, are equal to 2×10^{-5} and 4×10^{-5} sec, respectively. A counter circuit with compensation of the input-circuit capacitance is presented, which allows a measurement channel resolving time of $\sim 3 \times 10^{-5}$ sec to be realized. (auth)

24522 RADIATION SERVICE LIFE OF ENCAPSULATED PROPORTIONAL COUNTERS. Al'perovich, V. R.; Il'in, A. S.; Morgovskii, L. Ya. (Special Design Bureau of X-Ray Equipment, Leningrad). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 1, 78-80(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 1, 73-74(1973).

The causes of the limited service life of encapsulated proportional counters are investigated. The presence of a deposit on the anodes of used counters was revealed. The regularities governing the development of this deposit were studied, and the relationship between the characteristics of the deposit and the spectral parameters of the counter was traced. (auth)

24523 DETERMINATION OF THE SATURATION CURRENT IN AN IONIZATION CHAMBER FROM TWO EXPERIMENTAL POINTS. Volkov, N. G.; Gorbachenko, G. M.; Lyapidevskii, V. K. (Moscow Engineering-Physics Inst.). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 1, 105-107(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 1, 94-96(1973).

Based on previously derived equations, computation and graphical methods are proposed for determining the saturation current in ionization chambers from two experimental points. The methods were tested on flat chambers that were irradiated with β-particles and γ-quanta. (auth)

24524 ENGINEERING AND ABSOLUTE LUMINESCENCE YIELDS OF LUMINESCENT PLASTIC BASED ON POLYSTYRENE. Zlobin, L. I.; Moroz, G. L. (Biophysics, Inst., Moscow). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 1, 102-104(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 1, 92-94(1973).

The engineering and absolute luminescence yields of plastic scintillators based on polystyrene are presented, as determined by the method of comparison with the peak of one-electron noise pulses of an FEU-42 photomultiplier. It is shown that the yields are determined to a substantial degree by the fabrication technology of the scintillators. (auth)

24525 DEPENDENCE OF THE LUMINESCENCE YIELD OF A PLASTIC SCINTILLATOR ON THE ENERGIES OF ELECTRONS AND PROTONS. Kulinich, Yu. A.; Rukavishnikov, V. G.; Semenov, Yu. V.; Chineikin, M. T. Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 1, 95-98(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 1, 87-89(1973).

Results are presented of measurements of the relative luminescence yield of plastic scintillators in the range of electron energies from 78 to 410 keV and proton energies from 0.425 to 12.63 MeV. The results obtained are analyzed and compared with the experimental results of other papers. (auth)

24526 ELECTRON-OPTIC INSTALLATION FOR INVESTIGATING THE TIME PARAMETERS OF SCINTILLATORS. Ganeev, A. S.; Ivanov, G. A.; Kulakov, D. N.; Popov, V. M.; Svalukhin, A. I. Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 1, 92-94(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 1, 85-86(1973).

An installation is described for investigating the time parameters of scintillators. The excitation of the scintillators is carried out periodically by an electron beam. In order to record the luminescence of the scintillator an image converter is used whose time sweep is synchronized with the excitation. A time resolution of the order of tenths of a nanosecond was achieved. As an example, the deexcitation times of the fast components and the luminescence-yield ratios of the fast and slow components are presented for two plastic scintillators. (auth)

24527 RECORDING RADIOACTIVITY DISTRIBUTION ON A PHOTOGRAPHIC FILM. Bobrova, V. N.; Rys'ev, O. A.; Surov, N. A. Instrum. Exp. Tech. (USSR) (Engl. Transl.); 15: No. 6, 1769-1770(1972).

Translated from Prib. Tekh. Eksp.; 15: No. 6, 132-133(1972).

A device is described which allows the distribution of radioactivity in a two-dimensional sample to be recorded on photographic film. The samples and the photographic film are situated on a common moving table. The radioactivity of the sample is measured by a counter. The signal is transmitted to a neon lamp that illuminates the photographic film. Photorecording ensures the ability to record an activity of 5×10^{-8} Ci relative to tritium. (auth)

24528 ENERGY RESOLUTION OF SCINTILLATION COUNTERS WITH A LIGHTGUIDE. Danilov, V. S. Instrum. Exp. Tech. (USSR) (Engl. Transl.); 15: No. 6, 1688-1689(1972).

Translated from Prib. Tekh. Eksp.; 15: No. 6, 64-65(1972).

The use of a cylindrical lightguide in scintillation counters having an irised photomultiplier leads to an improvement in the energy resolution of the scintillation counter by a factor of 1.1 to 1.16. (auth)

24529 INSTRUMENTS FOR COUNTING TRACKS ON THE SURFACE OF SOLID TRACK DETECTORS. Zaichik, V. E. (Inst. of Medical Theology, Obninsk, USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 15: No. 6, 1669-1671(1972).

Translated from Prib. Tekh. Eksp.; 15: No. 6, 48-50(1972).

An instrument has been developed for the automatic measurement of the numerical density of tracks on microsectors of the

surface of detectors. The principle of operation of the instrument is based on recording the light scattered by the detector surface. It is shown that for a diameter of α-tracks equal to 2 to 3 μ a linear dependence is observed between the photocurrent and the numerical density of the tracks in the range of $6 \cdot 10^5$ to $2A \cdot 10^7$ α-tracks/cm^2. (auth)

24530 ANGULAR CHARACTERISTICS OF GLASS FISSION-FRAGMENT TRACK DETECTORS. Koroleva, T. V.; Kraitor, S. N. Instrum. Exp. Tech. (USSR) (Engl. Transl.); 15: No. 6, 1665-1668(1972).

Translated from Prib. Tekh. Eksp.; 15: No. 6, 45-47(1972).

The efficiency with which the fragments are recorded by a track detector made of silicate glass with targets made of ^{237}Np, ^{235}U, and ^{238}U was calculated with allowance for fission anisotropy. It was shown that the angular anisotropy of the fragments increases the efficiency when the detectors are irradiated along a normal to the surface and reduces it for irradiation along the surface. The variation of efficiency, depending on the neutron energy, may amount to 10 to 30%. The angular dependence of the efficiency with which the fragments are recorded was measured experimentally by neutron irradiation of detectors made of silicate glass with ^{237}Np and ^{238}U targets in the pulsed fast reactor of the Joint Institute of Nuclear Research (JINR). The results obtained are in agreement with the calculated data. (auth)

24531 MEASUREMENT OF THE THICKNESS OF THE SENSING REGION OF SILICON DETECTORS. Selyutin, V. P.; Kridiner, L. S.; Gatsenki, L. S.; Fedoseeva, O. P. Instrum. Exp. Tech. (USSR) (Engl. Transl.); 15: No. 6, 1676-1679(1972).

Translated from Prib. Tekh. Eksp.; 15: No. 6, 54-56(1972).

The thickness w of the sensing region of the silicon detectors is determined from the position of the Landau peak of the internal-conversion electrons (i.c.e.) of ^{207}Bi. The quantity w and the thickness d of the dead layer of transit detectors is determined from the ionization losses of i.c.e. with an error of 10% in the 300 to 1000 μ range. In mass measurements using an installation that has undergone preliminary calibration, w is determined from the efficiency of the total-absorption peak with an error of 10% in the 500 to 1500 μ range. (auth)

24532 PORTABLE PLUTONIUM DETECTOR. Burton, B. S.; Anastasi, M. N. (Nuclear-Chicago Corp., Austin, TX). Anal. Instrum.; 10: A7-A16(1972).

From 18th annual ISA analysis instrumentation symposium; San Francisco, California, USA (3 May 1972). See CONF-720596-.

A survey instrument for detection of fissile materials is described. The instrument is designed for use in harsh environments in the field. L x-rays, or gamma rays, from the fissile material are detected by a probe with a CaF_2(Eu) scintillator. Pulse-height analysis enables selective detection of these radiations in the presence of background. A digital display indicates the counting rate in the pulse-height window. The absolute sensitivity is ~24 counts/min per μg/m^2 of ^{239}Pu on a uniformly contaminated surface with no overburden. Eight prototypes have been constructed. Several instruments have been tested in accordance with MIL-STD-810E, with good results. Design and development studies are discussed; physical and operational characteristics are described. (auth)

24533 SPECIAL SMALL-GRAINED PHOTOGRAPHIC EMULSIONS FOR NUCLEAR INVESTIGATIONS, DOSIMETRY, AND AUTORADIOGRAPHY. Perfilov, N. A.; Novikova, N. R.; Zakharov, V. I. Zh. Nauch. Prikl. Fotogr. Kinematogr.; 18: No. 3, 220-230(1973). (In Russian).

The properties of 12 types of special small-grained nuclear photographic emulsions were examined. The elementary composition and the granulometric and recording characteristics of the individual types are reported. The methods for the photographic processing of the emulsions are given in detail. These include the usual development in specially developed developers, discrimination development, and the process of photographic intensification. The areas for the use of the emulsions are described, and the possible future development of photographic methods with the use of special small-grained emulsions is examined. (tr-auth)

24534 EFFECT OF SILVER IODIDE ON THE PROPERTIES OF COARSE-GRAINED X-RAY EMULSIONS. Bogomolov, K. S.; Donskaya, S. A. Zh. Nauch. Prikl. Fotogr. Kinematogr.; 18: No. 3, 161-162(1973). (In Russian).

Experimental data on the investigation of the effect of silver iodide on the photographic and granulometric properties of coarse-grained x-ray emulsions are reported. The photosensitive layer was exposed to the x-ray device RUP-200 and processed in solutions of three developers: x-ray (total), surface, and sub-surface. The study showed the independence of the x-ray sensitivity on the concentration of the silver iodide for a given constant value of the size of the emulsion grains. In the emulsions containing iodide, subsurface hidden images, slightly developed by developers of the surface type, were formed. (tr-auth)

24535 EXPERIMENTAL DETERMINATION OF THE UNIVERSAL CHARACTERISTICS OF AN IONIZATION CHAMBER. Ivanov, V. I.; Avchiev, I. A. Meas. Tech. (USSR) (Engl. Transl.); 16: No. 1, 98-101(Jan 1973).

Translated from Izmer. Tekh.; 16: No. 1, 62-64(Jan 1973).

Experimental investigations of the current–voltage characteristics of plane-parallel and cylindrical ionization chambers are discussed. Universal characteristic curves, obtained by averaging the current–voltage characteristics for all cases of the experiment, are plotted. (WHK)

24536 METHODS OF MEASURING NOISE IN SEMICONDUCTOR NUCLEAR RADIATION DETECTORS. Zakharchuk, O. V. Meas. Tech. (USSR) (Engl. Transl.); 16: No. 1, 92-95(Jan 1973).

Translated from Izmer. Tekh.; 16: No. 1, 59-60(Jan 1973).

The concept of the actual noise energy equivalent which defines the signal-to-noise ratio in semiconductor detectors is introduced, and the methods of noise measurement in semiconductor detectors are classified. (WHK)

24537 THERMOLUMINESCENT DETECTOR HAVING A SMALL PATH HAVING HARDNESS. Kudelin, K. M. Meas. Tech. (USSR) (Engl. Transl.); 16: No. 1, 151-152(Jan 1973).

Translated from Izmer. Tekh.; 16: No. 1, 92-93(Jan 1973).

The design of a partially shielded LiF thermoluminescent dosimeter is described, and the relations are derived for determining the area and thickness of the shield. (WHK)

Radiation Dosimeters

Refer also to abstracts 24655 and 25004.

24538 (AERE-R-7008) NUCLEAR ACCIDENT DOSIMETRY SYSTEMS; U. K. MEASUREMENTS AT THE SECOND I.A.E.A. INTERCOMPARISON AT O. R. N. L., MAY 1971. Delafield, H. J.; Boot, S. J.; Dennis, J. A. (Atomic Energy Research Establishment, Harwell (England)). Jan 1972. 31p. Dep. NTIS (U. S. Sales Only) $3.75. UK £1.00.

Teams from 13 countries compared their systems for assessing doses in criticality accidents by simultaneously exposing dosimeters to a series of mixed pulses of neutron and gamma radiation produced by the Health Physics Research Reactor at O. R. N. L. The Harwell team made measurements both in free air and on phantoms using personnel criticality dosimeters and a threshold detector system. The reactor was operated bare for pulse 1, and shielded by steel and lucite for pulses 2 and 3 respectively. Surface absorbed doses of 316, 216 and 51 rads due to heavy recoil particles, and 107, 65 and 77 rads due to gamma radiation were received by the man-phantom facing the reactor in the three respective exposures. These doses are derived from the personnel criticality dosimeter (including the body sodium activity for pulse 2) and film dosimeter gamma measurements. The threshold detector system (TDS) exposed in a free air position gave values of neutron kerma of 384, 183 and 44 hectoerg.g^{-1} of standard man tissue for the three respective pulses. Spectra derived from the TDS measurements are also presented. (auth)

24539 (LA-UR-73-1262) PROGRESS IN PERSONNEL NEUTRON DOSIMETRY. Hankins, D. E. (Los Alamos Scientific Lab., N. Mex.). 1973. 13p. (CONF-730907-11). Dep. NTIS $3.00.

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

Recent progress in personnel neutron dosimetry is reviewed. A survey of the various albedo-neutron dosimetry systems that have been developed shows the advantages and disadvantages of each of the systems. The energy dependence of the albedo-neutron dosimeters is rather poor, and the effect of this on their accuracy and usefulness is discussed. Fission-fragment damage to polycarbonates has been studied extensively, with most investigators using the spark-counter technique for evaluation. A survey is made of the systems currently in use, and the problems associated with their use are discussed, including sensitivity, evaluation time, and exposure of the wearer to the fissionable material. Other systems under study but not yet in practical application are discussed briefly and include thermally stimulated exoelectron emission (TSEE), direct response of thermoluminescent-dosimeter (TLD) materials to fast neutrons, and the response of TLD materials to recoil protons. (auth)

24540 THERMOLUMINESCENT PROPERTIES OF LITHIUM BORATE ACTIVATED BY SILVER. Thompson, J. J.; Ziemer, P. L. (Purdue Univ., Lafayette, IN). Health Phys.; 25: No. 4, 435-441(Oct 1973).

To determine the effect of various impurities on the thermoluminescent properties of lithium borate, 60 phosphors were initially prepared which were individually doped with three different concentrations of manganese, cobalt, magnesium, silver or one of 15 rare earth elements. Silver and manganese were the only impurities which showed a significant enhancement of thermoluminescence; all others had no effect on lithium borate. The silver activated phosphors exhibited glow curves consisting of peaks at 100° and 175°C and emission spectra consisting of two broad peaks in the ultraviolet at 290 and 365 nm. The high temperature peak of $Li_2B_4O_7$: Ag showed good stability at room temperature when stored in the dark; however, considerable fading occurred when the irradiated phosphor was exposed to fluorescent lighting. Lithium borate activated with silver showed a tendency to absorb less moisture from the air than did $Li_2B_4O_7$: Mn. Because of the high atomic number of silver, the calculated energy response of $Li_2B_4O_7$: Ag was found to be critically dependent upon the activator concentration at concentrations greater than 0.1 M%. The most favorable theoretical energy response occurs at a concentration of about 0.1 M%. The ultraviolet emission spectrum of $Li_2B_4O_7$: Ag represents a considerable improvement over the yellow-orange spectrum of $Li_2B_4O_7$: Mn, with respect to detector efficiency and to infrared blackbody interference. Combined with the proper detection system, $Li_2B_4O_7$: Ag should be useful for detecting lower radiation exposures than is currently possible with $Li_2B_4O_7$: Mn, without sacrificing a favorable energy response. (auth)

24541 DOSIMETRY OF IONIZING RADIATIONS. Dejehet, F. (Univ., Louvain, Belgium). Rev. Quest. Sci.; 144: No. 2, 169-188 (1973). (In French).

The measurement of ionization produced by radiation in a gas constitutes the principal method for the determination of exposure and absorbed doses. The theory of the ionization cavity furnishes a relation that permits the evaluation of the dose absorbed in an irradiated medium starting with that absorbed, and thus measured, by the detector. In its general form, this theory is applicable to any dosimeter regardless of its dimensions and its physical state. The formulas permitting the calculation of the absorbed dose are given for the various conditions of irradiation and the transposition to the case of any dosimeter is indicated. (tr-auth)

24542 REACTOR GAMMA HEAT MEASUREMENTS WITH COLORIMETERS AND THERMOLUMINESCENCE DOSIMETERS. Haack, K.; Majborn, B. (Danish Atomic Energy Commission, Roskilde). Nucl. Instrum. Methods; 111: No. 2, 282-286(1973).

Intercomparison measurements of reactor γ-ray heating were carried out with calorimeters and thermoluminescence dosimeters. Within the measurement uncertainties the two methods yield coincident results. In the actual measurement range thermoluminescence dosimeters are less accurate than calorimeters, but possess advantages such as a small probe size and the possibility of making simultaneous measurements at many different positions. Hence, thermoluminescence dosimeters may constitute a valuable supplement to calorimeters for reactor γ-ray heating measurements. (auth)

24543 INTEGRAL-PULSE IONIZING-RADIATION DETECTORS. Dmitriev, A. B.; Kryukova, I. N.; Filatov, A. I.; Pravotorov, V. V. Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 1, 71-72(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 1, 67-68(1973).

The principle of operation and characteristics of integral-pulse radiation detectors consisting of an ionization chamber and a built-in spark gap connected in series are described. The detector produces a pulse shaped by the spark gap after the chamber has acquired a specific integral radiation pulse. The instruments are designed to measure absorbed doses of charged particles and γ radiation in the dosage-power range from 3×10^{-4} to 6×10^{2} R/h. (auth)

24544 EFFECT OF SOLUTE CONCENTRATION AND TEMPERATURE ON THE CERIC-CEROUS DOSIMETER. Matthews, R. W. (Australian Atomic Energy Commission, Sutherland). Radiat. Res.; 55: No. 2, 242-255(Aug 1973).

The effects of oxygen and ceric ion concentrations and irradiation temperature on $G(Ce^{3+})$ were determined at various cerous ion concentrations in dosimeter solutions for the 0.01 to 5.0 megarad range. Potentiometric and spectrophotometric methods of analysis were used in studying the effect of initial ceric ion concentration on $G(Ce^{3+})$. Particular care was taken in determining $G(Ce^{3+})$ values for the various solute parameters used in the above dose range to eliminate the need to calibrate solutions against the Fricke dosimeter. A simple equation gives $G(Ce^{3+})$ with high precision for any initial ceric or cerous ion concentration used in the above dose range and any normal irradiation temperature. Deoxygenation and oxygenation of solutions respectively decrease and increase the $G(Ce^{3+})$ value obtained from aerated solutions at any particular cerous ion concentration. The oxygen effect is attributed to intraspur scavenging of hydrogen atoms. It is shown that $G(Ce^{3+})$ at zero solute concentration can only be estimated with accuracy if the oxygen effect is taken into account. (auth)

Nuclear Spectroscopic Instrumentation

Refer also to abstract 25717.

24545 (AERE-R-7294) USE OF THRESHOLD DETECTORS TO EVALUATE NEUTRON LEAKAGE SPECTRA FOR DOSIMETRY CALCULATIONS. Boot, S. J. (Atomic Energy Research Establishment, Harwell (England)). Dec 1972. 30p. Dep. NTIS (U. S. Sales Only) $3.50. UK 50 pence.

The problem of obtaining a neutron spectrum from a set of threshold detectors is reviewed and a method is presented which optimizes the parameters to describe a spectrum model. This is effected iteratively by minimizing the difference between experimental and calculated detector responses relative to known errors in the detector measurements. The system is applied to the experimental measurement of ten neutron leakage spectra from reactor and criticality assemblies and some comparison with other methods of spectrum measurement is made. (auth)

24546 (EUR-4954, pp 483-510) TIME FOCUSING METHODS IN THERMAL NEUTRON SPECTROMETRY AND THEIR APPLICABILITY TO PULSED NEUTRON SOURCES. Meister, H. (EURATOM, Ispra, Italy). Apr 1973.

From joint meeting on pulsed neutrons and their utilization; Ispra, Italy (17 Sep 1971).

Four proposals for neutron spectrometers were studied. The first two employ the Doppler effect in neutron reflection from rotating and vibrating crystals respectively in order to obtain time focusing onto the detectors for neutrons scattered quasi-elastically in the sample. They are examined from the point of view of possible application to pulsed neutron sources. It appears that for differing reasons both these spectrometers are more suitable for a steady state reactor than a pulsed neutron source. Another proposal concerns a new method of measuring the scattering function S(k) for liquids and amorphous substances and for the separation of the scattering functions of binary systems. A pulsed quasi-monochromatic neutron beam with a well-defined wave-length range impinges upon the sample. Neutrons scattered in the sample towards the detector with the same value of momentum transfer k, independent of the scattering process being elastic or inelastic, arrive at the detector at one time t if the primary and secondary flight paths are equally long. This relation $t \sim |k|$ is valid to a first approximation only, which means for a limited energy transfer. Still, by the principle of this method its k-accuracy is better than that of the conventional measuring technique using a double axis spectrometer. Time focusing is envisaged also for a time-of-flight powder diffractometer of one or a few times 10 m flight path length. If the detector units composed of many ^{3}He-tubes are properly arranged on cones around the axis of the incident beam they may cover ranges of the scattering angle up to 30 degrees giving the same resolution as thin ring detectors. Here time focusing is a matter of convenience and economizes on electronics and data handling. (EU)

24547 (IFA-FN-42-1972) RESOLUTION FUNCTION OF A TRIPLE AXIS NEUTRON SPECTROMETER. Grabcev, B. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Obninsk. Fiziko-Energeticheskii Institut). 1972. 19p. INIS.

The amplitude and shape of the resolution function of a triple-axis neutron spectrometer are calculated in Gaussian approximation. Formulae containing the explicit analytical dependence of the resolution function on incoming and scattered neutron wave vectors as well as on instrumental parameters, in forms suitable for computer programming are obtained. The case of the double-crystal monochromator is also considered. (auth)

24548 (IFA-SR-5-1973) INTERFACING OF THE MOESSBAUER SPECTROMETER ASA WITH THE ANALYZING SYSTEM NTA-512B. Sampaleanu, M. M.; Morariu, M. (Institutul de Fizica Atomica, Bucharest (Romania)). 1973. 6p. Dep. NTIS (U. S. Sales Only) $3.00.

Interfacing and operation of the motor drive system and the data acquisition and processing system are briefly described. (WHK)

24549 (INDC(SEC)-31-U, pp 3-15) MULTI-ANGLE TIME-OF-FLIGHT SPECTROMETER. Yamanouti, Y.; Tanaka, S. (Japan Atomic Energy Research Inst., Tokai). Jan 1973.

In topical discussion on inelastic scattering of fast neutrons.

A multi-angle time-of-flight spectrometer for fast neutron scattering experiments in conjunction with the JAERI 5.5 MV Van de Graaff accelerator is described. The spectrometer consists of four simultaneously operational detectors placed in 10° steps on a large turntable which is rotatable around the scattering sample. And the maximum flight paths are 8 m. In the performance test, time spectra of neutrons elastically and inelastically scattered from carbon and iron in the energy regions around 20 MeV and below 8 MeV were observed over the angular range 30° to 155°. An overall time resolution of 2.5 ns was obtained. And since it is very important to reduce background neutrons especially for the experiments in the region around 20 MeV, several shapes of shadow bars which intercept neutrons entering into detectors directly from the neutron source were tried and the optimum shape was found. (auth)

24550 (ITJ-40) METHOD OF CORRECTIONS EVALUATION FOR GAMMA-RAY SELF-ABSORPTION IN SPATIAL SOURCES. Krzuk, J. (Institute of Nuclear Techniques, Krakow (Poland)). 1973. 15p. (In Polish). Dep. NTIS (U. S. Sales Only) $3.00.

A method for calculation of corrections for gamma-ray self absorption in spatial sources is described, which is valid for any shape of gamma detector as well as the source itself. (auth)

24551 (JEN-249) NEUTRON SPECTROMETRY WITH ORGANIC SCINTILLATION DETECTOR. Butragueno, J. L. (Junta de Energia Nuclear, Madrid (Spain)). 1972. 31p. (In Spanish). INIS.

A fast neutron spectrometer using a stilbene crystal as head detector with pulse shape discrimination (P.S.D.) to reject gamma background is described. The experimental procedure involves the P. S. D., the measurements to calibrate the spectrometer, and the corrections for several factors, mainly the non-linear response of the stilbene. Results of the measurements with the reaction $^{2}D(d,n)^{3}He$, and with an Am–Be neutron source are presented. The measurement of the spectrum of the fast reactor CORAL-1 is also presented. (auth)

24552 (KFKI-73-23, pp 62-73) CORRELATION METHODS IN NEUTRON SPECTROMETRY. Pellionisz, P. (ed.). Sep 1972.

In development of correlation instruments and measurement techniques with special regard to the application of correlation methods in neutron physics and reactor techniques. Final Report.

A short summary is given of the new experimental methods developed and used in correlation neutron spectroscopy studies. Equipment for spin-flipping and magnetic pulsing as well as a mechanical correlation chopper have been built. New methods have been developed and applied for correlation time-of-flight spectrometry and diffractometry and for filtering out certain spectrum components or separating elastically from inelastically scattered neutrons. The application of correlation methods has been extended to pulsed neutron sources. (auth)

24553 (LA-5260-T) NEW TECHNIQUES IN PRECISION GAMMA SCANNING. Application to Fast-Breeder Fuel Pins. Phillips, J. R. (Los Alamos Scientific Lab., N Mex.). Jul 1973. Contract W-7405-eng-36. 210p. Dep. NTIS $7.60.

A new precision gamma scanning system is described. The system is designed for the thorough, detailed, nondestructive characterization of irradiated fast reactor fuel pins. Gamma scanning data are given for failed fuel pins, transfer mechanisms of fission products, quantitative isotopic scanning, and differential burnup profiles. The system consists of a scanning mechanism for the precise positioning (±0.001 in.) of the irradiated fuel pin, high density tungsten alloy collimators for defining the volume segment from which the gamma-ray spectra are collected, a large high-resolution anticoincidence detector assembly for resolving complex gamma-ray spectra, and a computer controlled data acquisition unit with magnetic tape storage for processing and storing the gamma-ray spectra. The complete calibration of the gamma scanning system is presented. This includes the calibration of the effective collimating slit aperture, and the determination of the surface response matrices for the Ge(Li) detector as a function of gamma photon energy. The gamma scanning system is utilized for the characterization of irradiated fuel pins to determine physical dimensions, specific fission product distributions, fuel cladding failure of doubly encapsulated fuel pins, fast and thermal neutron flux profiles, and relative and absolute burnup profiles. The transfer mechanisms of ^{134}Cs and ^{137}Cs are investigated, showing the selective deposition of cesium on fuel pellets with high oxygen content. The determination of the differential burnup profiles of ^{235}U and ^{239}Pu mixed-oxide fuel materials is presented. The nondestructive quantitative determination of specific fission products by gamma scanning of irradiated materials is compared to destructive radiochemical assay. These gamma scanning results indicate that the method can be applied to the precise quantitative determination of specific fission products. A computer code, COLLUM, is described for the determination of the effective slit aperture of complex rectangular collimating slit assemblies. The quantitative determination of specific fission products is accomplished by applying a second computer code, QUADET, which allows the calculational simulation of the source response of cylindrical fuel pins. The integration of the scanning mechanism, collimators detector assembly, and data acquisition unit has resulted in a completely automated gamma scanning system. The new nondestructive techniques have been applied to the examination of over a hundred irradiated fast reactor fuel pins. (auth)

24554 COMPUTER CONTROLLED TRIPLE AXIS NEUTRON SPECTROMETER (TAS) WITH CAMAC INSTRUMENTATION AND A HIGH LEVEL COMPUTER LANGUAGE CONTROL PROGRAM. May, F.; Eder, O. J.; Schoitsch, E.; Schwarzer, J. (Forschungszentrum, Seibersdorf, Austria). Nucl. Instrum. Methods; 111: No. 2, 375-378(1973).

Hard- and software of a computer controlled triple axis spectrometer are described. The hardware system consists largely of CAMAC units, an internationally standardized modular system. For the software, a first approach to use a high level language has been made by attaching an overlay to FOCAL, which enables FOCAL to execute CAMAC commands. It is pointed out that for flexible process control a compilation to generate a fast code would be desirable. A lexical scanner phase for FOCAL, to get an immediately executable string of codes and pointers, is briefly discussed. (auth)

24555 EXPERIMENTAL STUDY FOR STABILIZING A SPECTRUM WITH NO REFERENCE PEAKS. Matoba, M.; Matsumoto, Y.; Hyakutake, M. (Kyushu Univ., Fukuoka). Nucl. Instrum. Methods; 111: No. 2, 259-262(1973).

A new method to stabilize a spectrum with no reference peaks was established experimentally. This method was further extended to a more general scheme of spectrum stabilization. (auth)

24556 DIGITAL MOESSBAUER EFFECT SPECTROMETER CONTROLLED BY THE MULTICHANNEL ANALYZER. Biran, A.; Berg, E.; Arad, D. (ELSCINT Ltd., Haifa, Israel). Nucl. Instrum. Methods; 111: No. 2, 393-396(1973).

A digital Moessbauer spectrometer with velocities of up to 600 mm/s is described. The spectrometer is controlled by the multichannel analyzer. The least significant bit from the parallel output of the M.C.A. advances an up/down scaler in the spectrometer. A digital-to-analog converter translates the contents of the scaler to an analogical wave which is given to the transducer. An analogical correction waveform which compensates for the shift of the transducer, is added to the triangular wave form and enables automatic on-line folding in the triangular mode. (auth)

24557 DISCRIMINATOR FOR USE WITH NaI(Tl) DETECTORS AT HIGH COUNTING RATES. Mills, A. P. Jr. (Brandeis Univ., Waltham, MA). Nucl. Instrum. Methods; 111: No. 2, 365-373 (1973).

A discriminator is described which is suitable for use in a multiple NaI(Tl) coincidence spectrometer at high counting rates. The device generates pulses whose lengths convey energy information, and energy compensated timing pulses for use in multiple fast coincidence measurements. (auth)

24558 REPRESENTATION OF AMPLITUDE DISTRIBUTION IN A SCALE PROPORTIONAL TO THE SQUARE ROOT OF THE ENERGY. Vyotskii, E. D.; Pan'kov, A. S. Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 1, 35-38(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 1, 36-39(1973).

The parameters of amplitude distributions in the $\sqrt{E}$ scale are considered. The efficiency of nonlinear conversion is estimated. Discrete and analog circuits are described which implement this scale in analyzers of the general type. (auth)

24559 PROPORTIONAL X RADIATION COUNTER WITH AN UNLIMITED OPERATING SERVICE LIFE. Klyukvina, E. F.; Chaikovskii, V. G.; Bogatova, E. P. Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 1, 76-77(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 1, 71-72(1973).

The construction and parameters of a proportional x-ray counter with a pure xenon filler are presented. The amplitude resolution for the 6.4 keV line is 18 to 20% within the limits of a working surface life equal to 10^{12} pulses for a gas multiplication factor $\sim 10^{4}$. (auth)

24560 GAS-DISCHARGE SPECTROMETRIC PROPORTIONAL COUNTER WITH A LOCK CHAMBER. Savel'ev, G. I.; Shlyagin, K. N. (Inst. of Biophysics, Moscow). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 1, 73-75(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 1, 68-70(1973).

A cylindrical counter is described which has lock chambers that

can be used to change and install a source inside or outside the sensing region without altering the pressure of the working gas in the counter. The counter is equipped with both end and side chambers. The gas-purification installation allows a vacuum of up to $\sim 10^{-3}$ torr to be created and permits the pressure of the working gas to be maintained in the range from several torr to 15 atm. Certain spectrometric characteristics of a counter for low-energy x radiation are presented. The counter may be used to perform measurement of x rays and γ rays having an energy of 1 to 100 keV. (auth)

24561 FABRICATION OF 4π–Ge(Li)-DETECTORS. Bylov, Ts.; Kuznetsov, V. V.; Osipenko, B. P.; Srnka, D.; Yurkovskii, Ya. (Joint Inst. of Nuclear Research, Dubna, USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 1, 81-84(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 1, 75-78(1973).

The technology of fabricating the Ge(Li)-detector with a through aperture is described. The detector parameters are given, and the γ-ray spectra of ^{155}Tb and ^{22}Na, as measured by means of this detector, are presented. (auth)

24562 DEPENDENCE OF THE PARAMETERS OF SCINTILLATION BLOCKS ON THE RELATIONSHIP BETWEEN THE DIMENSIONS OF THE CRYSTALS AND THE PHOTOMULTIPLIER. Sobornov, O. P.; Fedoseev, G. A. (Inst. of Geochemistry and Analytical Chemistry, Moscow). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 1, 99-101(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 1, 90-91(1973).

The parameters of scintillation blocks (scintiblocks) were considered for overhang of the exit window of the detector (NaI(Tl) crystals having a large diameter) over the working area of the photomultiplier cathode. Dependences that relate both the luminescence yield and the energy resolution of the scintiblocks to the relative area of the exit window of the detector (this area determines the degree of overhang) are obtained which are convenient for practical utilization. (auth)

24563 BD-9 INTEGRAL DISCRIMINATOR IN THE CIRCUIT OF A FAST-NEUTRON SCINTILLATION DETECTOR. Inanov, E. A.; Usatyuk, V. V. (Inst. of Earth Physics, Moscow). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 1, 117-118(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 1, 105-106(1973).

The use of a BD-9 integral discriminator in the circuit of a scintillation neutron detector with discrimination of γ-radiation according to the shape of the pulse is described when the variation of the frequency characteristic of the pulse provides the possibility of eliminating pulses corresponding to high-energy γ-quanta. (auth)

24564 ELECTROSTATIC ANALYZER FOR SEPARATING FISSION FRAGMENTS. Arifov, Yu. A.; Belyaev, A. D.; Kogan, V. I.; Pikul, V. P.; Teplyakov, R. V.; Usmandiyarov, A. M. (Electronic Inst., Tashkent). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 15: No. 6, 1652-1654(1972).

Translated from Prib. Tekh. Eksp.; 15: No. 6, 34-36(1972).

An electrostatic analyzer situated in the horizontal channel of a reactor and serving jointly with a semiconductor detector for purposes of separating nuclear fission fragments according to their energies and effective changes is described. The construction of the analyzer ensures convenience of alignment, the required accuracy of the geometric parameters, the absence of electrical discharges, and reliability of operation. The spectra of the kinetic energies and the effective charges of the ^{235}U fission fragments were obtained. (auth)

24565 HANDLING SPECTRA FROM SEMICONDUCTOR DETECTORS IN A SEMIAUTOMATIC SYSTEM CONTAINING STORAGE DEVICES AND AN ELECTRONIC COMPUTER. Arlt, R.; Winter, G.; Medved, S. V.; Musiol, G.; Sinaev, A. N.; Usmanova, Z. A.; Fromm, D.; Chistov, N. A.; Shtrusnyi, Kh. (Joint Inst. of Nuclear Research, Dubna, USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 15: No. 6, 1696-1707(1972).

Translated from Prib. Tekh. Eksp.; 15: No. 6, 71-83(1972).

In order to handle the spectra from semiconductor detectors a semiautomatic system has been created that contains storage devices and electronic computers. The information from the spectrometric equipment is recorded in a measurement-storage device, and after completion of exposure it is automatically transmitted to a buffer storage device. This device is equipped with an oscilloscope having a light pencil, by means of which monitoring, labeling, and selection of information for further handling is performed. Preliminary handling of the information is performed on a "Minsk-22" computer into which it is fed via a cable communication line. Final handling of the spectra is carried out on a CDC-160 4A electronic computer according to the programs: Gamma-D1 (analysis of γ-spectra and conversion-electron spectra), Beta (analysis of β-spectra) and Converse (determination of the energy of γ-transitions from the energy spectrum of conversion electrons). (auth)

24566 Ge(Li)-DETECTOR WITH SEPARATED SENSING REGIONS FOR GAMMA-SPECTROMETRY WITH SUPPRESSION OF THE COMPTON BACKGROUND. Akinshin, B. K.; Pakhomov, E. E.; Pakhomova, A. L.; Polytsya, O. P. Instrum. Exp. Tech. (USSR) (Engl. Transl.); 15: No. 6, 1672-1675(1972).

Translated from Prib. Tekh. Eksp.; 15: No. 6, 50-53(1972).

A planar Ge(Li)-detector for γ-spectrometry with suppression of the Compton background is described. In order to separate the sensing regions of the detector the method of local electrochemical etching was used. The block diagram of the spectrometer and the results of measurements are presented. More than a four-fold suppression of the Compton background was obtained. A coaxial detector with separated sensing regions was used to obtain thirty-seven-fold suppression of the Compton background. (auth)

24567 SYSTEMS FOR STABILIZING AN ADDING COMPTON SPECTROMETER. Ivanov, V. B.; Leshchinskii, A. G.; Shimanskii, A. M.; Shipilov, V. I. Instrum. Exp. Tech. (USSR) (Engl. Transl.); 15: No. 6, 1733-1736(1972).

Translated from Prib. Tekh. Eksp.; 15: No. 6, 104-107(1972).

Adding Compton spectrometers allows the search for and analysis of weak γ-lines against the background of more intense lines to be simplified. The block diagram of such a spectrometer which is used for technological purposes, the schematic of the digital stabilization system designed on the basis of an adder using analog elements, and certain features of the application of adding Compton spectrometers are described. (auth)

24568 SHAPE OF THE LINE OF A NEUTRON SPECTROMETER THAT INCORPORATES A STILBENE CRYSTAL. Trykov, L. A.; Tyufyakov, N. D.; Fadeev, Yu. V. Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 1, 53-57(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 1, 51-55(1973).

The shapes of the line of a neutron spectrometer having a stilbene crystal with the dimensions ranging from 10×10 to 70×70 mm are given for neutrons having an energy ranging from 0.2 to 18 MeV. The experimental data are compared with data calculated according to the Monte-Carlo method. (auth)

24569 SOME ASPECTS OF γ RAY SPECTROMETRY IN CONJUNCTION WITH NUCLEAR REACTORS. Bechemilh, J. P.; Lecomte, P.; Le Meur, R.; Roquefort, H.; Rouvier, P. (CEN de Saclay, Gif-sur-Yvette, France). Ind. At. Spatiales; 17: No. 2, 15-24(Mar 1973). (In French).

A germanium–lithium detector γ-spectrometry installation associated with a MULTI-8 computer is presented. A brief description is given of the electronics. The installation is provided with a magnetic tape unit enabling a rapid information output followed by a simple computer processing. This processing involves analyzing the spectra with automatic location of peaks, determination of abscissa, and measurement of areas. In addition, the processing includes the calibration of the spectrometer in terms of energy and efficiency. In this way the radioisotopes present in a sample can be identified. Certain applications are envisaged using a radiation loop and other reactor circuits. (FR)

24570 ^{75}Se AS AN EFFICIENT CALIBRATION STANDARD FOR Ge(Li) DETECTORS. Lavi, N. (Soreq Nuclear Research Center, Yavne, Israel). Radiochem. Radioanal. Lett.; 14: No. 5-6, 385-388(5 Sep 1973).

The energies and relative intensities of the gamma rays emitted in the decay of ^{75}Se were measured. This source is recommended for use as a calibration standard for Ge(Li) detectors. (auth)

High Energy Physics Instrumentation

Refer also to abstract 26113.

24571 (BNL-18177) STRESS ANALYSIS OF EXPANSION PISTON (PROTOTYPE I) FOR NAL 30K LITER HYDROGEN BUBBLE CHAMBER. DiLullo, C.; Gardner, D. W.; Goodzeit, C. L. (Brookhaven National Lab., Upton, N. Y.). Aug 1973. 32p. Dep. NTIS $3.75.

The prototype design of the expansion piston for the NAL 30,000 liter hydrogen bubble chamber is a composite structure consisting of a 71-inch diameter outer fiber glass shell with a stainless steel inner structure for transmitting the pressure load to the piston shaft. The assembly was analyzed for both static and cyclic loading conditions mainly with the use of finite element computer programs. The stresses and deflections in the various components were calculated and plotted and the edge loads necessary to achieve compatability of deformations between the members were estimated by successive iterations from finite element solutions. In addition, the maximum interlaminar shear areas were determined for the fiberglass, the bolting between the piston shaft and structure was checked and the recommended pre-load was determined. (auth)

24572 DESCRIPTION OF A DIGITAL CONTROLLER. Brooks, C. B. (Oxford Univ.); Centro, S. Nucl. Instrum. Methods; 111: No. 2, 275-281(1973).

A data acquisition system designed for a bubble chamber film scanning machine is greatly versatile and can be used for many other purposes. Mainly, it could be used as a general facility for fast data acquisition, buffering and control in on-line experiments, in connection with a mini or medium size computer. (auth)

24573 COSMIC RAY ISOTOPE RESOLUTION OBTAINED USING A NEW CHERENKOV-TOTAL ENERGY-dE/dx TELESCOPE. Webber, W. R.; Lezniak, J. A.; Kish, J. (Univ. of New Hampshire, Durham). Nucl. Instrum. Methods; 111: No. 2, 301-314(1973).

In the summer of 1972 a new large area cosmic ray telescope was flown on a balloon at Ft. Churchill. This telescope was designed to study the isotopic composition of $Z > 2$ nuclei using a new technique employing a combination of Cherenkov and total energy counters ($C \times E$), as well as simultaneous measurements using a more conventional $dE/dx \times E$ technique. The theoretical response of the various telescope elements, and the mass resolution using both the $dE/dx \times E$ and $C \times E$ techniques are discussed. Mass resolutions ranging from 0.2 amu for He nuclei, 0.35 amu for C nuclei, and increasing to ≈1.5 amu for Fe nuclei are obtained for the energy range 100 to 600 MeV/nucl. using the $dE/dx \times E$ technique. The $C \times E$ technique may only be used for nuclei with $Z \geq 10$, over limited energy ranges between 300 and 700 MeV/nucl., however, the mass resolution using this technique is considerably superior. The $C \times E$ technique achieves mass resolutions $\lesssim 0.4$ amu for Si nuclei increasing to ≈0.8 amu for Fe nuclei. The mass resolution using this latter approach shows considerable scope for improvement and mass resolutions <0.4 amu for Fe and lighter nuclei are easily within reach of present technology. Several possible future developments to extend the energy range of applicability and improve still further the mass resolution obtainable using this technique are discussed. This includes systems employing several Cherenkov counters, and multi-dimensional mass analysis techniques employing combinations of $C \times E$ and $dE/dx \times E$ systems. (auth)

24574 SPARKOSTRICTIVE WIRE-CHAMBER SPECTROMETER. Cence, R. J. (Univ. of Hawaii, Honolulu); Harris, F. A.; Jones, B. D.; Morgado, R. E.; Shiraishi, L. M.; Yount, D. E.; Perez-Mendez, V.; Van Tuyl, R.; Clarke, D. B. Nucl. Instrum. Methods; 111: No. 2, 379-391(1973).

The development of a sparkostrictive wire-chamber spectrometer is described. The spectrometer consists of 9 chambers ranging in active width-times-height from 91 cm × 81 cm to 152 cm × 91 cm. The chambers are positioned between the 152-cm-diameter pole faces of the Lawrence Berkeley Laboratory M5 magnet, which has a 120-cm gap and a 6-kG field in this application. The grid wires are spaced 1 mm apart and on most chambers are oriented with wires running vertically and at ±30° angles to the vertical to provide three redundant coordinates per track. The root-mean-square spatial resolution is typically 1.6 mm. The chambers, while capable of one-track efficiencies of virtually 100% and three-track efficiencies averaging better than 98% per track, are extremely delicate and require constant attention. The various steps taken to achieve high efficiencies are analyzed, and the performance during a recent K^+_{e4}–$K^+_{\pi ee}$ experiment involving more than 1.6×10^6 triggers is evaluated. (auth)

24575 SCINTILLATION SINGLE CRYSTAL TIME SPECTROMETER. Morozov, V. A.; Muminov, T. M. (Joint Inst. of Nuclear Research, Dubna, USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 1, 85-87(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 1, 79-81(1973).

A single-crystal time spectrometer is described for measurement of the lifetimes of excited states of nuclei. The lifetimes of the ^{169}Tm level having an energy of 316 keV ($T_{\frac{1}{2}}$ = (640 ± 14)nsec) and of the ^{139}Pr level having an energy of 822 keV ($T_{\frac{1}{2}}$ = (35.5 ± 0.7)nsec) were measured. (auth)

24576 AMPLITUDE ANALYSIS OF STREAMS OF PARTICLES FROM AN EXTENSIVE ATMOSPHERIC SHOWER. Gadalov, A. N.; Kaganov, I. I.; Silaev, A. A. (Scientific-Research Inst. of Nuclear Physics, Moscow). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 1, 39-42(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 1, 39-42(1973).

The suitability of amplitude-time conversion for scintillation pickups that record the particle density of an extensive atmospheric shower is investigated. Logarithmic conversion is achieved either by an RC-circuit or by an RLC ringing tank circuit. An RC-converter having a dynamic range of 10^4 and a nonlinearity <10% is described. The error of measuring signals does not exceed 10% in the 5 to 35°C temperature range. The correlation field of the points is presented for two pickups at the observation point. (auth)

24577 RECORDING THE PROCESSES OF PHOTOPRODUCTION OF π^{-1} MESONS ON NUCLEI. Epaneshnikov, V. D.; Kuznetsov, V. M.; Stukov, O. I. (Scientific-Research Inst. of Nuclear Physics, Moscow). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 1, 32-34(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 1, 34-35(1973).

A method of determining the cross sections of processes of the $\gamma + {}_zA \rightarrow \pi^- + {}_{z+1}A$ type is considered which is based on measurement of the β^+ activity of nuclei. In order to identify the investigated reaction channel, fast-slow $(\gamma\gamma)$ β coincidences and analysis of the energy spectrum of the annihilation quanta were used. The equipment and results of investigating the $\gamma + {}^{12}C \rightarrow \pi^- + {}^{12}N$ process are described. (auth)

24578 STREAMER CHAMBER HAVING THE DIMENSIONS 100 × 60 × 40 cm IN A MAGNETIC FIELD. Alikhanov, A. I.; Ainutdinov, M. S.; Artem'ev, V. A.; Knyazev, V. M.; Pershin, I. I.; Soloshchenko, V. A. (Inst. of Theoretical and Experimental Physics, Moscow). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 1, 61-63(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 1, 58-60(1973).

A three-electrode streamer chamber having the dimensions 100 × 60 × 40 cm was exposed to a beam of π-mesons from the accelerator of the Institute of Theoretical and Experimental Physics in a magnetic field of ~20 kG. A hydrogen-filled target whose housing was fabricated from foam polyurethane was situated inside the working cavity of the chamber. The accuracy with which the coordinate of the streamer in the plane of the chamber electrodes was determined amounted to ~(0.20 ± 0.01) mm. (auth)

24579 EFFECT OF THE SHAPE OF THE RADIATORS ON THE ENERGY RESOLUTION OF CHERENKOV SHOWER SPECTROMETERS. Varfolomeev, A. A.; Glebov, V. I.; Denisov, E. I. (Atomic Energy Inst., Moscow). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 1, 49-52(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 1, 48-51(1973).

Using an electronic computer, the yield of Cherenkov electromagnetic-shower radiation from high-density radiators of shower spectrometers is calculated by means of an electronic computer. Results are obtained for two radiator shapes: cylinders and truncated cones. It is shown that the shape of the radiators has a substantial effect both on the light yield and the magnitude of the light signal, and on the fluctuations of the light signals which develop as a result of fluctuations of the shape of the angular and spatial distributions of the shower particles. The conical shape is more advantageous. (auth)

24580 IDENTIFICATION OF CHARGED PARTICLES IN A FREON BUBBLE CHAMBER. Goncharov, N. V.; Derebchinskii, A. I.; Konovalov, O. G.; Tonapetyan, S. G.; Khvorostyan, V. M. (Physicotechnical Inst., Kharkov). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 1, 64-66(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 1, 61-63(1973).

It was shown that for operation of a freon chamber in a mode with moderate overheating with stabilization of the reference pressure, reliable identification of stopped $\pi^{\pm}$-mesons and protons is possible against a background of other secondary particles that develop as a result of the interaction of high-energy photons with nuclei. The work was performed without a magnetic field. (auth)

24581 DESTRUCTION OF A FILM ELECTRODE IN A SPARK CHAMBER. Kozhanov, E. V.; Nurgozhin, N. N.; Nurzhakipov, T. N. (Inst. of High-Energy Physics, Alma-Ata, USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 1, 67-68(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 1, 63-65(1973).

The results of investigating the damage inflicted by the action of a spark discharge on a metallized lavsan film used as the electrode of a spark chamber are presented. Only the metal coating is subjected to damage in the case when it faces toward the inside of the chamber. The damage from sparks having a thickness of 1.5 mm take the form of a circle 0.5 mm in diameter on the anode and a circle 1.5 mm on the cathode. The dimensions of the damaged areas decrease with decreasing spark power and increasing thickness of the metallic coating of the lavsan film. The possibility of using the damage of the metallized film in order to obtain information from spark chambers is noted. (auth)

24582 TIME AND AMPLITUDE CHARACTERISTICS OF SCINTILLATION COUNTERS UNDER CONDITIONS OF LARGE PULSE LOADINGS. Kazarinov, M. Yu.; Lyaiste, R.; Merekov, Yu. P.; Petrukhin, V. I.; Ronzhin, A. I.; Khovanskii, N. N.; Khovanskii, N. N.; Tsisek, Z. (Joint Inst. of Nuclear Research, Dubna, USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 1, 88-91(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 1, 81-84(1973).

The time and amplitude characteristics of scintillation counters with 56AVP and 56DVP photomultipliers were investigated for pulse loadings of up to 2×10^7 sec^{-1} on the synchrotron of the Institute of High-Energy Physics. (auth)

24583 MEMORY MATRICES BASED ON FERRITE RINGS FOR SPARK WIRE CHAMBERS. Karpekov, Yu. D.; Konstantinov, V. F.; Makarov, G. P.; Prokhorov, A. N.; Simonov, Yu. N. (Inst. of High-Energy Physics, Serpukhov, USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 15: No. 6, 1708-1710(1972).

Translated from Prib. Tekh. Eksp.; 15: No. 6, 83-85(1972).

The construction and method of fabrication of ferrite memory matrices for spark wire chambers are described. The mechanization of the threading of a portion of the windings allowed the laboriousness of fabricating the matrices to be reduced by a factor ~10 in comparison with that corresponding to completely manual technology. Descriptions of the corresponding mechanical devices are provided. (auth)

24584 WORKING MODE OF A STREAMER CHAMBER. Rudenko, N. S.; Smetanin, V. I. (Tomsk Polytechnic Inst., USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 15: No. 6, 1659-1661 (1972).

Translated from Prib. Tekh. Eksp.; 15: No. 6, 39-42(1972).

The working range of a streamer chamber in the electric-field-intensity interval from 6 to 25 kV/cm was investigated by the electron-optic method. Based on the data obtained, a discussion is given on the conditions governing the recording of particle tracks in a chamber. (auth)

24585 SEMIAUTOMATIC PHOTOMETER FOR DETERMINING THE CHARGES OF HEAVY COSMIC-RAY NUCLEI IN PHOTONUCLEAR EMULSIONS. Kulikov, V. N.; Pyatigorskii, G. A.; Yakubovskii, E. A.; Varyukhin, V. V.; Gagarin, Yu. F.; Ivanova, N. S. (Leningrad Physical-Technical Inst.). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 15: No. 6, 1662-1664(1972).

Translated from Prib. Tekh. Eksp.; 15: No. 6, 42-44(1972).

A photometer is described which allows simultaneous measurement of various parameters of the tracks of primary nuclei in a broad range of charges. A semiautomatic system for taking background light absorption into account in the emulsion is used in the instrument. Methods are described for the charge calibration of the instrument. (auth)

24586 THRESHOLD CHERENKOV COUNTER. Onuchin, A. P.; Serednyakov, S. I. (Inst. of Nuclear Physics, Novosibirsk, USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 15: No. 6, 1680-1681 (1972).

Translated from Prib. Tekh. Eksp.; 15: No. 6, 57-58(1972).

A threshold Cherenkov counter is described which was used for separating pions and kaons from colliding electron-positron beams. The neutral area of the counter is 420 × 420 mm, and the type of light collection is diffuse. The efficiency with which relativistic particles are recorded amounts to (99.3 ± 0.4)%. (auth)

24587 CHERENKOV SHOWER SPECTROMETER WITH A CONICALLY SHAPED RADIATOR MADE OF TF-5 GLASS. Varfolomeev, A. A.; Glebov, V. I.; Denisov, E. I.; Khlebnikov, A. S. Instrum. Exp. Techn. (USSR) (Engl. Transl.); 15: No. 6, 1682-1684 (1972).

Translated from Prib. Tekh. Eksp.; 15: No. 6, 59-61(1972).

The construction of a Cherenkov power spectrometer with a radiator made of the densest optical glass TF-5 shaped in the form of a truncated cone is described (volume ~8.7 liters, depth 15 rad. units). The calibration characteristics obtained using an electron beam is linear in the energy range 0.425 to 48 GeV. The energy resolution of the spectrometer varies from 22 to 70% in this energy interval. (auth)

24588 LARGE SCINTILLATION COUNTER HAVING A HIGH AMPLITUDE RESOLUTION. Kuzin, Yu. N.; Rapoport, I. P.; Titenkov, A. F. (Moscow State Univ.). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 15: No. 6, 1685-1687(1972).

Translated from Prib. Tekh. Eksp.; 15: No. 6, 61-63(1972).

Based on polymethylmethacrylate a scintillation counter having a large size and a high amplitude resolution (~2 to 3%) has been created which is suitable for the investigation of ionizing relativistic particles. (auth)

24589 SPOT-FOCUSING CHERENKOV COUNTER FOR THE DETECTION OF MULTIPARTICLE EVENTS AT HIGH ENERGIES. Benot, M.; Howie, J. M.; Litt, J.; Muenier, R. (CERN, Geneva). Nucl. Instrum. Methods; 111: No. 2, 397-412(1973).

A new type of Cherenkov counter is described for the detection of multiparticle events emitted from a small-size production target. The detector focuses the Cherenkov light produced by a particle of a given velocity β_0 to a spot image. The counter produces an output of the angular coordinates and, for particles having γ values within a given range, provides a determination of the velocity of each detected particle. The general principles of the design of this type of detector are presented, together with the computed results for a particular example. (auth)

24590 HIGH ENERGY PARTICLE IDENTIFICATION USING MULTILAYER PROPORTIONAL COUNTERS. Jeanne, D.; Lazeyras, P.; Lehraus, I.; Matthewson, R.; Tejessy, W.; Aderholz, M. (CERN, Geneva). Nucl. Instrum. Methods; 111: No. 2, 287-300 (1973).

An optimised system of proportional counters consisting of 128 layers (32 channels each, 190 × 60 cm^2 detection area) is being developed to work in connection with the Big European Bubble Chamber at SPS energies. It will be capable of identification of simultaneous particles up to 70 GeV/c by ionization measurements in the region of the relativistic rise. Preliminary tests with a reduced version of 32 layers have been made with pions, kaons and protons at 16 GeV/c, the results of which are presented. (auth)

Radiometric Instruments

Refer also to abstract 24643.

24591 RADIOMETRIC MEASUREMENTS OF THE PARAMETERS OF HYDROTRANSPORT OF INDUSTRIAL PIPELINES. Przewlocki, K.; Nizegorodcew, P. (Akademia Gorniczo-Hutnicza, Krakow). Houille Blanche; 28: No. 1, 59-64(1973).

Radiometric methods of measuring mean flow velocity, mean density, and spatial distribution of solids in a liquid-solid flow are presented. The measurements of density and spatial distribution of concentration are based on the attenuation of a radiation beam in the matter. A tracer technique is used for the determination of mean velocities. (FR)

24592 COAL DUST INCOMBUSTIBLES CONTENT ANALYZER. Armstrong, F. E. (Bureau of Mines, Bartlesville, OK). Anal. Instrum.; 10: A17-A20(1972).

From 18th annual ISA analysis instrumentation symposium; San Francisco, California, USA (3 May 1972). See CONF-720596-.

An instrument using a gamma-ray backscatter technique for determining the weight percent incombustibles content of coal dust and rock dust mixtures in coal mines has been built and tested. The unit gives a direct readout in percent incombustibles for rock dust mixtures containing between 50 and 100% incombustibles; calibration of the device requires using a sample of the rock dust employed; this is usually limestone but occasionally dolomite or gypsum. A small americium-241 source is used with a scintillation detector whose output feeds a ratemeter. The source-detector geometry used was chosen to reduce the effects of variation in bulk density. Accuracy of the system is within ±3% for most mixtures. The instrument is portable and completely self-contained; the rechargeable batteries supply power for 300 to 400 determinations. (auth)

24593 LICENSING OF TYPES OF EQUIPMENT. Arbeitsschutz (Cologne); No. 10-11, 402(1972). (In German).

The licensing of a ^{63}Ni electron capture detector type is described. (GE)

24594 DENSITY PATTERNS OF THE INHOMOGENEOUS LIQUIDS IN THE INDUSTRIAL PIPE-LINES MEASURED BY MEANS OF RADIOMETRIC SCANNING. Michalik, A. (Akademia-Gorniczo-Hutnicza, Krakow). Houille Blanche; 28: No. 1, 53-57(1973).

Results of research carried out on industrial hydraulic installations are given. Density patterns have been measured by means of radiometric scanning in a pipe (diameter = 200 mm). Density distribution of a flowing mixture was measured under the following conditions: mean velocity of flow V = 4.00 m/s ± 10%; mean density of flowing mixture ρ = 1.10 to 1.90 g/cm^3. Preliminary analysis of about one hundred measured density patterns is presented. (FR)

Radiation Effects on Instrument Components, Instruments, or Electronic Systems

Refer also to abstracts 24397 and 24398.

24595 (SLA-73-5416) LARGE SIGNAL S-PARAMETERS: MODELING AND RADIATION EFFECTS IN MICROWAVE POWER TRANSISTORS. Graham, E. D. Jr.; Chaffin, R. J.; Gwyn, C. W. (Sandia Labs., Albuquerque, N Mex.). 1973. 13p. (CONF-730828-2). Dep. NTIS $3.00.

From microwave semiconductor devices, circuits and applications conference; Ithaca, New York, USA (14 Aug 1973).

The concepts and techniques relevant to the large-signal S-parameter characterization scheme are reviewed. Experimental results showing Class C circuit waveforms as well as preirradiation and postirradiation large-signal S-parameter data are presented. An entirely new and highly accurate modeling technique for bipolar transistor circuit performance is introduced. The technique features the uses of the exact one-dimensional device analysis code with a circuit analysis code (SCEPTRE). It is shown to be applicable to microwave power transistors under nonlinear Class C operating conditions. The modeling requires a doping profile for the chip and a model for the transistor package. It provides a method both for optimizing the package parasitic elements for a transistor chip and for simulating the total device response in an RF circuit. The circuit simulation code was used to study microwave transistor response under conditions similar to those for which experimental data are presented. Excellent agreement between experiment and calculated results point to the usefulness of this technique. The experimental and computed waveforms in these studies exhibit a near sinusoidal shape, hence the large signal S-parameter technique is both valid and useful. (auth)

24596 PARTIAL RESULTS ON CdS AND CdTe THIN FILM SOLAR CELLS SPATIAL RELIABILITY. Bernard, J.; Berry, J.; Buisson, J. P.; Paillous, A. (Centre d'Etudes et de Recherches en Technologie Spatiale, Toulouse). pp 229-240 of Solar Cells. New York; Gordon and Breach, Science Publishers, Inc. (1971).

From international meeting on solar cells; Toulouse, France (6 Jul 1970). See CONF-700707-.

Solar cells were introduced into a vacuum chamber and heated to 80°C for 200 h by means of the radiation from a tungsten lamp. The solar cells were irradiated under vacuum with electrons of various energy levels. The spectral response of each solar cell was determined before and after each test. Particular attention was given to a study of the photovoltaic properties of the CdS solar cell. (IAA)

24597 BEHAVIOR OF LITHIUM IN IRRADIATED SOLAR CELLS. Carter, J. R. Jr.; Downing, R. G. (TRW Systems Group, Redondo Beach, CA). pp 275-290 of Solar Cells. New York; Gordon and Breach, Science Publishers, Inc. (1971).

From international meeting on solar cells; Toulouse, France (6 Jul 1970). See CONF-700707-.

The current state of the art in radiation-resistant lithium-doped silicon solar cells is reviewed. Fabrication techniques are reviewed. Characteristics of lithium-doped cells are discussed. Behavior of lithium-doped cells during 1 MeV electron irradiation is studied for various types of cells. Effects of variations in lithium and oxygen concentration are shown and discussed. Capacitance measurements at various voltages, frequencies and temperatures are used to detect charges in lithium donor concentration and the formation of defects during irradiation. Physical models to explain the observed effects are presented. (auth)

24598 INFLUENCE OF LITHIUM DOPANT ON THE PROPERTIES OF IRRADIATED SILICON. Goldstein, B.; Caillot, M.; Cherki, M.; Kalma, A. H. (Ecole Normale Superieure, Paris). pp 291-301 of Solar Cells. New York; Gordon and Breach, Science Publishers, Inc. (1971).

From international meeting on solar cells; Toulouse, France (6 Jul 1970). See CONF-700707-.

Photoconductivity and EPR studies were conducted in the investigation. It was found that the presence of oxygen affects strongly the defects produced by the irradiation. In case of oxygen-free material at least four types of complexes were formed as a result of the interaction of lithium with the defects produced by irradiation at 77°K. The recovery of sample properties at room temperature after irradiation occurs only in oxygen-free silicon with low Li concentrations. (IAA)

24599 TESTING OF SOLAR CELLS FOR COMMUNICATION SATELLITES. Curtin, D. J. (COMSAT Labs., Clarksburg, MD). pp 605-621 of Solar Cells. New York; Gordon and Breach, Science Publishers, Inc. (1971).

From international meeting on solar cells; Toulouse, France (6 Jul 1970). See CONF-700707-.

A discussion of the solar-cell research program at COMSAT Laboratories, which has involved several types of solar-cell testing including electron and proton irradiation tests as well as the evaluation of solar-array performance on INTELSAT spacecraft is presented. In addition, applied research has been carried out on new types of silicon solar cells, interconnect materials, and solar-array technology, along with a developmental program on cadmium-sulfide solar cells. (IAA)

24600 EFFECTS OF PROTON AND ELECTRON RADIATION ON FRENCH SILICON SOLAR CELLS. Bernard, J. (Centre d'Etudes et de Recherches, Toulouse); Buisson, J. P.; Jacquin, M.; Genre, R.; Pigneret, J. pp 623-637 of Solar Cells. New York; Gordon and Breach, Science Publishers, Inc. (1971).

From international meeting on solar cells; Toulouse, France (6 Jul 1970). See CONF-700707-.

The degradation of solar cells by nuclear radiation was experimentally studied. The electric and photovoltaic properties were examined as function of two parameters, i.e., the energy and integrated fluxes of protons and electrons. The damage coefficients were determined by measuring the diffusion length of minority carriers using photovoltaic and electrovoltaic methods. Emphasis was also placed on the problem of filter influence on solar cells. In order to study the action of different components, cells without filter, cells with filter, and filters were irradiated. Theoretical calculations of the influence of filters were also conducted. (IAA)

24601 ELECTRON AND PROTON DAMAGE ON SILICON SOLAR CELLS. Greco, G.; Misiano, C. (Selenia S.p.A, Rome). pp 639-650 of Solar Cells. New York; Gordon and Breach, Science Publishers, Inc. (1971).

From international meeting on solar cells; Toulouse, France (6 Jul 1970). See CONF-700707-.

After a brief analysis of the principal components of space radiation, some theoretical considerations are given on the effects of monoenergetic particle beams on the general properties of a semiconductor. The damage caused by 1-MeV-electrons and low-energy protons on electrical, optical, and mechanical characteristics of silicon solar cells is then briefly examined. Description is also given of experiments performed on Type SC 21 Selenia solar cells. The techniques used for the evaluation of electrical and optical characteristics of solar cells are discussed. Finally, a brief account is given of the design principles and fabrication techniques which have allowed the radiation damage to be limited to particularly low values. (IAA)

Miscellaneous Instruments

Refer also to abstracts 24633, 24667, 24668, 26182, 26621, 26856, 26872, 26888, 26911, 26913, 26917, and 26937.

24602 (KFKI-73-23, pp 1-8) STATISTICAL INSTRUMENTATION TECHNIQUE. Pellionisz, P. (ed.). Sep 1972.

In development of correlation instruments and measurement techniques with special regard to the application of correlation methods in neutron physics and reactor techniques. Final Report.

A short summary is given of the recent improvements in statistical instrumentation achieved at the Institute by researchers engaged in work under IAEA research contract 855/R1/RB. The correlators used in the measurement of stochastic signals consist of a conventional multichannel analyzer combined with special plug-in units. Refinements of the correlation technique as well as additional instrumentation (high-sensitivity ammeters and signal conditioners) are also discussed. (auth)

24603 (KFKI-73-23, pp 13-23) NON-PARAMETRICAL DETECTION METHODS. Kozmann, G.; Szlavik, F. (eds.). Sep 1972.

In development of correlation instruments and measurement techniques with special regard to the application of correlation methods in neutron physics and reactor techniques. Final Report.

Some fundamental problems in the monitoring of noisy systems that were tackled within the scope of IAEA Research Contract No. 855/R1/RB are discussed. A review is presented of the Kolmogorov-Smirnov method, which has proved an effective tool for the fast detection of certain changes in stochastic processes. The consistency of Kolmogorov-Smirnov decisions is considered in detail. For technical implementation of the method the effect of the quantization error also needs to be taken into account. An approach to this problem is described and information is given on the construction and functioning of a Kolmogorov-Smirnov detector based on a TPA small computer. (auth)

24604 (NIM-1530) AUREOL: AN X-RAY-ABSORPTION ANALYZER FOR THE DETERMINATION OF THE URANIUM ON LOADED RESIN IN ION-EXCHANGE PLANTS. Chaix, R. P.; Zimmer, C. H. E. (National Inst. for Metallurgy, Johannesburg (South Africa)). 19 Apr 1973. 24p. Dep. NTIS (U.S. Sales Only) $3.25.

The AUREOL analyzer was developed for the determination of uranium on loaded resin in continuous ion-exchange and resin-in-pulp pilot plants. Both the on-line and off-line versions gave accuracies within their specifications. The AUREOL systems would be suitable for use on ion-exchange plants for the recovery of any of the heavy metals where shift sampling and analysis are required for plant control. (auth)

24605 (ORNL-4868) MEASUREMENT OF SHOCK OVER-PRESSURE IN AIR BY A YIELDING FOIL MEMBRANE BLAST GAUGE. Manweiler, R. W.; Chester, C. V.; Kearny, C. H. (Oak Ridge National Lab., Tenn.). Sep 1973. Contract W-7405-eng-26. 30p. Dep. NTIS $4.00.

An inexpensive yet accurate pressure gauge was designed making use of the relationship between the peak pressure of a single-step rise shock loading and the permanent plastic deformation of thin foil membranes when subjected to shock loading. The gauge is of extremely simple design, is easy to use, and requires no electronic equipment. Peak shock over-pressures from a few psi to hundreds of psi can be measured to about 10% accuracy. The relevant theory of shock loading of thin foil membranes is presented, the calibration procedure using a shock tube is given, and the results of experimental field tests are given and compared to standard shock over-pressure measurements. (auth)

24606 (ORNL-TM-3740(Rev. 1)) QUALITY ASSURANCE PLAN FOR THE LARGE-SCALE PROCUREMENT OF TEMPERATURE SENSORS. Herskovitz, M. B. (Oak Ridge National Lab., Tenn.). Aug 1973. Contract W-7405-eng-26. 14p. AT.

A quality assurance program plan was prepared for large-scale procurement of thermocouple bulk material and assemblies. This plan meets the requirements of AEC-RDT Standards F 1-1, F 2-4T, and C 7-6T and describes the functions and responsibilities of each participant, i.e., the seller, the user, and ORNL personnel in specifying, procuring, storing, assembling, testing, and shipping bulk materials, assemblies, and samples. (auth)

24607 (SGAE-2148) CAMAC 1 TIMER-COUNTER. Schwabach, H.; Gratel, P.; Attwenger, W. (Oesterreichische Studiengesellschaft fuer Atomenergie G.M.B.H., Seibersdorf. Elektronikinstitut). Jun 1973. 15p. (In German). Dep. NTIS (U.S. Sales Only) $3.00.

24608 VELOCITY SPECTROMETER WITH SEPARATED FIELDS. Wollnik, H.; Muenzenberg, G.; Ewald, H. (Justus Liebig-Univ., Giessen, Ger.). Nucl. Instrum. Methods; 111: No. 2, 355-364(1973). (In German).

A velocity filter is calculated which in contrast to the classical Wienfilter consists of separated sector fields. In this design much smaller magnets are required. Above all, however, one can achieve in this way much higher electrostatic field strengths since the electrodes can be designed for an optimal high voltage performance. A velocity filter using separated sector fields furthermore can focus stigmatically more easily than a classical Wienfilter. (auth)

24609 STUDY OF DATA TRANSFER IN THE CAMAC BRANCH. Meyer, J. M.; Mlynek, D.; Metzger, G. (CRNS, Strasbourg). Nucl. Instrum. Methods; 111: No. 2, 263-268 (1973). (In French).

A theoretical discussion is given of the CAMAC interconnection: Dataway and Branch Highway. A programme which calculates the value of each individual reflected wave at every time and point in an interrupted line is described and application to CAMAC is given. The importance of some technical precautions is also emphasized. (auth)

24610 PULSE AMPLIFIER FOR NUCLEAR INSTRUMENTATION. Herbst, L. J. (Teesside Polytechnic, Eng.). Nucl. Instrum. Methods; 111: No. 2, 269-273(1973).

The amplifier described is suitable for general nuclear instrumentation. It has a maximum voltage gain of 5500, and the customary facilities of attenuation, RC or delay line differentiation, and integration with a choice of time constants extending from 0.05 to 10 μs. Integrated circuits are used in the intermediate stages of amplification. (auth)

24611 LARGE-CAPACITY MEMORY BASED ON LINEAR MATRICES. Grachev, A. G. (Joint Inst. of Nuclear Research, Dubna). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 1, 113-116(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 1, 101-104(1973).

A version of a large-capacity memory consisting of the simplest linear memory matrices is presented for an address drive that in economy is comparable with the address drives of three-dimensional (3D) memories. Under these conditions all of the advantages inherent in one-matrix two-dimensional (2D) memories are retained by the memory version considered. (auth)

24612 PRELIMINARY HANDLING OF INFORMATION DURING RECORDING IN A MEMORY OF THE INTEGRATING TYPE. Balamatov, N. N.; Turin, V. S. (Scientific-Research Inst. of Nuclear Physics, Moscow). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 1, 111-112(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 1, 99-101(1973).

In performing measurements of various characteristics of random processes in experimental nuclear physics it frequently becomes necessary to perform the following preliminary operations in recording information: subtraction and multiplication or squaring. Multiplication and squaring are especially important in recording information in a memory of the integrating type, in pulse analyzers, and in summing counters, since this allows important statistical cnaracteristics (the dispersion and the spectrum) to be obtained during the course of the experiment. The principle of operation and logical design of a device that performs the operation indicated is described. (auth)

24613 ELECTRONIC KEYBOARD COMPUTERS IN AUTOMATED INSTALLATIONS. Mityugov, A. G.; Volkov, V. P. (Scientific-Research and Design Inst. of the Rare Metals Industry, Moscow). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 15: No. 6, 1692-1695(1972).

Translated from Prib. Tekh. Eksp.; 15: No. 6, 68-71(1972).

Problems of using the "Iskra 12" and "Iskra 22" batch-manufactured electronic keyboard computers in automated installations are considered along with the couplings of these computers to the recording equipment; the simplicity of including them in the automatic operating mode is noted. The structure of the block for matching the electronic keyboard computers to the recording equipment is displayed. Using the example of a computer device designed on the basis of the "Iskra 12," which is incorporated in an automated installation for neutron-activation analysis, the choice of the number of cycles and commands of the matching block is considered, its developed block-diagram and the principal characteristics of the control pulses are described. (auth)

24614 UNITIZED OUTPUT SHAPER IN FAST ELECTRONIC CIRCUITS. Basiladze, S. G. (Joint Inst. of Nuclear Research, Dubna, USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 15: No. 6, 1746-1751(1972).

Translated from Prib. Tekh. Eksp.; 15: No. 6, 116-120(1972).

A unitized output shaper for fast nuclear-electronic circuits is described. The output shaper has a dead time that is shorter than the duration of the delay time and allows avoidance of missed counts if the secondary input signal arrives within the hold interval. The hold time of the shaper can be controlled within the limits of a tenfold range; its minimal value is 4 nsec, and its maximum value is 4 msec. Circuits using this unitized output shaper are given for the statistical-pulse shaper, the pulse generator, the coincidence circuit, and the integral discriminator. (auth)

24615 MAGNETIC RESONANCE MASS-SPECTROMETER FOR STUDYING THE ISOTOPIC COMPOSITION OF HELIUM. Mamyrin, B. A.; Shustrov, B. N.; Anufriev, G. S.; Boltenkov, B. S.; Zagulin, V. A.; Kamenskii, I. L.; Tolstikhin, I. N.; Khabarin, L. V. (Leningrad Physical-Technical Inst.). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 15: No. 6, 1787-1789(1972).

Translated from Prib. Tekh. Eksp.; 15: No. 6, 148-150(1972).

The parameters are given of a mass-spectrometric installation that allows measurement of the absolute and relative content of ^{3}He isotopes in solid and gaseous samples of different origin right up to $^3He/^4He = 10^{-10}$. The maximum sensitivity of the mass-analyzer with respect to ^{3}He is $5 \cdot 10^5$ atoms. The resolving power of the installation is sufficient for complete isolation of ^{4}He and ^{3}He peaks from the multiplet background peaks. During operation over a period of ≈4 years the installation has demonstrated high performance and stability of the metrological parameters. (auth)

24616 APPARATUS FOR PULSED NEUTRON WELL-LOGGING. Bobrowski, C. (Instytut Techniki Jadrowej, Krakow). Tech. Poszukiwan; 10: 4-7(1972). (In Polish).

Apparatus for neutron pulse well-logging is described and criteria for choice of working conditions of a probe of well neutron generator are discussed in detail. Influence of time analyser parameters upon measurement accuracy is presented. (auth)

24617 PROGRAMMED CONTROL UNIT FOR A MULTI-CHANNEL PULSE HEIGHT ANALYZER USED IN THE DIGITAL RECORDING OF ACTIVITY PEAKS IN RADIOTRACER FLOW MEASUREMENTS. Korbel, K. (Inst. of Nuclear Physics, Krakow); Wolski, K. Nukleonika; 18: No. 6, 265-272(1973).

A description of the programmed control unit that was developed for a measuring assembly of the digital recording of concentration-time curves in radiotracer measurements of mass transport is given. This unit allows the memory channels of the analyzer to be used only for the data accumulation within the activity peaks, while the expected time intervals for passing the tracer between the injector and first detector as well as between the succeeding detectors are preset in the unit itself. (auth)

24618 LORENTZ FACTOR IN SINGLE-CRYSTAL NEUTRON DIFFRACTION. Iizumi, M. (Japan Atomic Energy Research Inst., Tokai). Jap. J. Appl. Phys.; 12: No. 2, 167-172(Feb 1973).

The Lorentz factor in the expression of the integrated intensity of a Bragg reflection is examined by taking account of the instrumental resolution of a two-crystal neutron diffractometer. If there is a collimator just before the detector, the Lorentz factor deviates considerably from the form commonly used, except for the case of 0 to 2θ-scan in which the expression of common use is exactly correct. The case of the filter-monochromatized x-ray diffraction is also investigated for comparison. (auth)

ISOTOPE AND RADIATION SOURCE TECHNOLOGY

Isotope Separation (Industrial)

Refer also to abstract 24237.

24619 PARTIALLY IONIZED PLASMA CENTRIFUGE. Lehnert, B. (Kungliga Tekniska Hoegskolan, Stockholm). Phys. Scr.; 7: No. 3, 102-106(1973).

The partially ionized plasma centrifuge contains a neutral gas mixture of isotopes or elements, the motion of which is driven by a small amount of rotating plasma. The plasma motion is, in its turn, controlled by externally imposed electric and magnetic fields. Earlier investigations of the centrifuge were extended by an analysis of its operating conditions. It is shown that high rotational velocities, large separation degrees, and stable velocity profiles can be achieved at comparatively small power losses, within certain ranges of the parameters involved. (auth)

24620 URANIUM ENRICHMENT BY GAS CENTRIFUGE. Avery, D. G.; Davies, E. M and B Technical Library TL/CE/2. New York; Crane, Russak and Company, Inc. (1973). 96p. $7.50.

Worldwide demand for ^{235}U enriched to levels around 2 to 4% is expected to increase substantially in the next decade, and the gas centrifuge is seen as a more economic method for future expansion of enrichment capacity, superseding the gaseous diffusion technique. The theory and methods of isotope separation, theory and types of gas centrifuges, engineering design of centrifuges, characteristics of a cascaded centrifuge plant, and the economic factors which will affect the extent to which industrial expansion of the gas centrifuge is successful are described. Appendixes are included on maximum separative power of a centrifuge; general partial differential equation for a centrifuge; partial differential equation of the countercurrent centrifuge; and flow profiles. A general bibliography, author index, and subject index are provided. (LCL)

24621 ONE-DAY MEETING OF THE GERMAN ATOMIC FORUM AT ACHEMA 1973. Energiewirt. Tagesfragen; 23: No. 7, 381-382(1973). (In German).

Lectures in the series "The Chemical and Economical Problems in the Enrichment of Uranium" are reported. Following a few general considerations, the separation nozzle process is particularly dealt with as well as the currently used diffusion process and the centrifuge process. The problem of the chemical-technical process of the transformation of uranium oxide into uranium hexafluoride is reviewed. (GE)

Isotopic Power Sources

Refer also to abstracts 24385 and 24764.

24622 (LA-5215) MEASUREMENTS OF HELIUM RELEASE FROM MATERIALS CONTAINING $^{238}PuO_2$. Mulford, R. N. R.; Mueller, B. A. (Los Alamos Scientific Lab., N. Mex.). Jul 1973. Contract W-7405-eng-36. 11p. Dep. NTIS $4.00.

Measurements of the isothermal helium release rates as a function of time for five materials containing 80% ^{238}Pu are described. The materials were plasma-torch microspheres, and cylindrical 1/4- by 1/4-in. pellets of PuO_2, PuO_2-56 wt % ThO_2, PuO_2-7 wt % ZrO_2, and PuO_2-35 wt % ZrO_2. Attempts to fit the data with a classical diffusion model, and the deviations therefrom, are discussed. (auth)

24623 (MLM-1270) PLUTONIUM-238 ISOTOPIC POWER SOURCES: A SUMMARY REPORT. Grove, G. R.; Powers, J. A.; Goldenberg, N.; Kelly, D. P.; Prosser, D. L. (Mound Lab., Miamisburg, Ohio). 7 Jun 1965. Contract AT(33-1)-Gen-53. 234p. Dep. NTIS $13.75.

Declassified 31 Oct 1972.

In 1962, Mound Laboratory started a comprehensive program to investigate the properties of ^{238}Pu and its compounds as potential heat sources for use in space, terrestrial, and marine applications. Results of the isotopic fuel studies including pertinent physical, chemical, nuclear, and mechanical information on Pu fuels and containment materials are summarized. Manufacturing methods and quality control procedures for fuel encapsulation and capsule integrity are outlined. A description is given of the radioisotopic heat sources for SNAP-3, SNAP-9A, SNAP-15A, SNAP-15B, SNAP-15C, and SNAP-19C. (TFD)

24624 (MLM-1365) HEAT SOURCE FABRICATION. Hincks, J. A.; McKinley, L. C. (Mound Lab., Miamisburg, Ohio). 1 Sep 1966. Contract AT(33-1)-Gen-53. 35p. Dep. NTIS $3.75.

Declassified 31 Oct 1972.

Radioisotopic heat sources using polonium-210 and plutonium-238 as fuels were fabricated. The methods of preparing the various forms of the fuels are discussed. The types of containers and the welding procedures used in the encapsulation of the fuels are described. Quality control procedures which are followed during preparation of the container materials, through fabrication and shipping of the completed heat source capsules, are included. Several examples of heat sources prepared for various programs are described. (auth)

24625 (MLM-1428) DART SUMMARY REPORT. Phipps, K. D.; Bonnell, P. H.; Johnson, E. W. (Mound Lab., Miamisburg, Ohio). 15 Jun 1967. Contract AT(33-1)-Gen-53. 17p. Dep. NTIS $3.00.

Declassified 31 Oct 1972.

In cooperation with the United States Air Force and TRW Systems, the Decomposed Ammonia Radioisotope Thruster (DART) was tested in the Mound Laboratory Thruster Test Facility. TRW Systems designed and built this experimental space thruster and the heat source components; Mound Laboratory fabricated the fuel ($^{238}PuO_2$ microspheres) and the heat source, and assembled the thruster. Welding parameters and techniques were evaluated on identical capsules prior to the fabrication and assembly of the loaded thruster. The thruster was assembled, installed in the test facility vacuum chamber, and tested for approximately three weeks. The thermal performance of the thruster exceeded design objectives, but leaks in the propellent flow tubes early in the performance test phases prohibited the generation of reliable thrust data. The thruster was moved to a vacuum system within an alpha box where it remained for 1152 hr at 950°C in a vacuum of 3×10^{-6} torr. A leak in the thruster water cooling line after 1152 hr resulted in the termination of the thruster extended life test. The radioisotopic capsule was placed in another heat shield package and an extended life test of the capsule was continued. (auth)

24626 (MLM-1519) MOUND LABORATORY ISOTOPIC POWER FUELS PROGRAMS: APRIL-JUNE 1968. (Mound Lab., Miamisburg, Ohio). 9 Aug 1968. Contract AT(33-1)-Gen-53. 70p. Dep. NTIS $5.50.

Declassified 31 Oct 1972.

Progress in the isotopic fuels program during April to July 1968 is reported. Fuel preparation methods and fuel characterization studies of ^{210}Po and ^{238}Pu fuels continued. Fuel/capsule compatibility tests were performed. Helium venting materials to be used in fabricating capsules were helium permeability and for ease of bonding to stainless steel holders. (LCL)

24627 (MLM-1524) SEPARATION AND DETERMINATION OF FINES IN PLUTONIUM DIOXIDE MICROSPHERES. Woltermann, H. A.; Jarvis, J. Y. (Mound Lab., Miamisburg, Ohio). 5 Mar 1968. Contract AT(33-1)-Gen-53. 13p. Dep. NTIS $3.00.

Declassified 31 October 1972.

An elutriation technique was developed for the separation of fines (material less than 47 μm in diameter) from plutonium dioxide microspheres. This elutriation procedure is a more efficient and more quantitative washing technique than the previously used ultrasonic cleaning method. Also, alpha counting an aliquot of the wash solution after dissolution of the plutonium dioxide provides a method for determining the quantity of fines removed from microspheres. (auth)

24628 (ORNL-4917) ORNL ISOTOPIC POWER FUELS QUARTERLY REPORT FOR PERIOD ENDING JUNE 30, 1973. Lamb, E. (Oak Ridge National Lab., Tenn.). Sep 1973. Contract W-7405-eng-26. 32p. Dep. NTIS $4.00.

Compatibility tests of $^{244}Cm_2O_3$ with 18 materials in 67 couples began and will run at 900, 1100, 1400°C for periods of 2500 and 5000 h. A thorough analysis of the fuel used in the compatibility couples was completed. Short-term compatibility tests of $^{244}Cm_2O_3$ with ThO_2, ZrO_2, and Al_2O_3 are in progress. Free energy calculations for the reaction of $^{244}Cm_2O_3$ with C, Be, ZrO_2, and Al_2O_3 were made. Equipment for $^{244}Cm_2O_3$ property characterization (helium release, vapor pressure, x-ray diffraction, emissivity, heat capacity, dimensional stability) is being prepared and checked for operability. The measurements of solution rates of $^{244}Cm_2O_3$ in distilled water were completed. A comparison of vapor pressures of curium, plutonium, and americium oxides was made based on literature values. Modifications to the impact gun for hot cell operation are in progress. Neutron and gamma radiation measurements were made on a 61.3-W_t $^{244}Cm_2O_3$ source. The ^{240}Pu decay product will be removed from a 50-g batch of $^{244}Cm_2O_3$ to provide material for baseline characterization stud-

ies. Pellets for characterization and compatibility experiments were prepared in the Curium Source Fabrication Facility (SFF); variations in pellet quality were noted. Tamped powder densities in the range of 5.5 to 6.0 g/cm^3 were measured. The self-sintering behavior of $^{244}Cm_2O_3$ powder in layers of different thicknesses was noted; up to 0.5-cm-deep layers formed only light crusts, but a 2-cm-dia by 2-cm-deep body of powder formed into a hard mass. (auth)

Radiation Sources

Refer also to abstracts 24402, 24410, 24570, and 26885.

24629 (IF-MR-37-1972) INFLUENCE OF VARIOUS FACTORS ON THE ELECTROLYTIC DEPOSITION RATE AT EXTENDED ^{90}(Sr + Y) SOURCES. Farcasiu, O.; Sahagia, M. (Institutul de Fizica Atomica, Bucharest (Romania)). 1972. 8p. INIS.

A method to obtain thin layers of ^{90}(Sr + Y) by electrodeposition on aluminum substrates is described. The influence of various physical and chemical factors on the electrolytic deposition rate and on the thin film quality is analyzed. The electrodeposition can be performed also at low voltages, resulting in thin, uniform sources of suitable adherence. The outlining and delimitation of the active area of the substrate is performed with the help of paraffin which avoids electrodeposition and contamination of the nonactive areas of the substrate. (auth)

24630 METHOD AND EQUIPMENT FOR RAPIDLY MEASURING BOTH LARGE AND SMALL LEAKS BY HELIUM FLUX MEASUREMENTS. Mars, J. (to Commissariat a l'Energie Atomique). French Patent 2,137,071. 12 May 1971. 8p. (In French).

A process is described which enables leaks from capsules used in the manufacture of sealed ^{238}Pu sources to be detected. The capsule is immersed in a helium bath. The helium flux emanating from the capsule is then subsequently measured with a mass spectrometer. The process is divided into two parts. In the first part, large leaks are detected by the herminifluage procedure. After immersion in helium, the capsule is put into a hermetic enclosure containing air at atmospheric pressure. The variations in the He flux coming out from the enclosure are measured, an intermediate variable conductance being used. The operation takes about one minute to perform. If the test produces negative results, a sweating technique is used to detect the small leak. The hermetic enclosure is evacuated and then directly connected to the spectrometer. Any helium flux coming from the capsule is measured. This operation is also very rapid (about 30 sec). (FR)

Design and Fabrication

24631 NEW PREPARATION METHOD FOR ^{57}Co MOESSBAUER SOURCES ON A COPPER MATRIX. Carrell, J. C. (Southern Illinois Univ., Carbondale); Dieterly, D. K. Nucl. Instrum. Methods; 111: No. 2, 333-335(1973).

A new method of preparation for ^{57}Co Moessbauer sources on a copper matrix has been devised which facilitates preparation of high activity sources having small active areas. The ^{57}Co is electroplated onto a copper foil, which is then overplated with copper. The resulting "sandwich" is then annealed in hydrogen. (auth)

24632 CAPSULE CONTAINING RADIOACTIVE IODINE TO BE ORALLY ADMINISTERED FOR THYROID FUNCTIONING DIAGNOSTICS AND THE METHOD FOR ITS PRODUCTION. Lennartz, K.; Schickel, E. (to Farbwerke Hoechst AG). German Patent 2,140,177. 22 Feb 1973. 7p. (In German).

The fabrication of a capsule containing ^{131}I or ^{131}I compounds is described. In contrast to other procedures, the iodine is dispersed in a physiologically harmless medium, e.g., a fatty acid ester which is solid at room temperature and liquid at body temperature. The radioactivity of the iodine is not affected by this procedure, furthermore, physiologically efficient substances may be added. The filling of the dispersed substance into a normal capsule of gelatine or a similar substance is described. The radioactivity of the iodine may be either 50 or 100 μCi. The capsule is intended for oral administration and is to be used in thyroid diagnostics. (GE)

Industrial Uses

Refer also to abstracts 24429, 24591, 24678, 24699, 24702–24721, 24726, 24743–24750, 26061, and 26773.

24633 (AERE-R-6709) EXAMINATION OF RADIOISOTOPE TECHNIQUES FOR THE MEASUREMENT OF VENTILATION RATE. Evans, G. V.; Webb, J. W. (Atomic Energy Research Establishment, Harwell (England)). Feb 1971. 27p. Dep. NTIS (U. S. Sales Only) $3.50. UK 23 pence.

The use of radioisotope tracers to measure ventilation-rates of simple and multiple enclosures is critically examined, and the accuracy of the methods is discussed in relation to results obtained from experiments in an experimental room with controlled ventilation. An instrument which measures ventilation-rate directly, following the rapid release of a radioisotope tracer, is described and its accuracy and operational advantages are demonstrated. (auth)

24634 (EUR-4868) APPLICATION OF ATOMIC ENERGY IN AGRICULTURE. Annual Report, 1970. (European Communities, Brussels (Belgium). Commission; Instituut voor Toepassing van Atoomenergie in de Landbouw, Wageningen (Netherlands)). Oct 1972. 90p. INIS.

Attention was given to the low dose irradiation of food products, which contain a relatively high percentage of substances such as fats and proteins. This was done in order to try to by-pass side-effects such as off-flavors. In the field of genetic control of agricultural insect pests, research into the application possibilities of the sterile male technique was carried out. Studies on the effects of radiation induced translocations in the onion fly and the spider mite have been started. Research into the transport of ^{90}Sr in different European soil types has been completed. Due to the good agreement between the calculated (simulation technique) and measured profiles, it is now possible to forecast the behavior of ^{90}Sr in the soil under different environmental (soil, climate) conditions. Research into radiation interaction in crystals and polymers is almost completed. The follow-up studies on biochemicals have already started. Dosimetry systems for practical applications (thermoluminescence of LiF and CaF_2 and the optical density of pre-treated perspex) have been made considerably more reliable as a result of a better insight into the primary processes occurring in these systems. Due to this, it was possible to carry out a dose comparison for fourteen radio-biological institutes from eight European countries in close cooperation with the Radiobiological Institute in Rijswijk. As far as the applications are concerned, it must be mentioned that the fresh mushrooms have been put on the market in Holland as the first irradiated foodstuff, and that a study committee has intensively prepared the way for the commercialization of irradiated potatoes. In the field of mutation breeding, a number of mutants of flowering plants (e.g. Alstroemia) were also put on the market. With regard to the genetic control of agricultural insects, research carried out has reached such a stage that the first practical tests with sterile males of the onion fly and the fruit tree leaf roller can be started. (INIS)

24635 (EURISOTOP–63) APPLICATION OF RADIOISOTOPES IN THE ALUMINIUM INDUSTRY. Winkhaus, G. (European Atomic Energy Community, Brussels (Belgium). Bureau Eurisotop). 103p. (In German). Dep. NTIS (U. S. Sales Only) $7.25.

The use of radioisotopes in a specific field of technology, the aluminium industry is reviewed. Many of the applications mentioned may undoubtedly be transferred directly or in adapted form to other technical fields. The study was based both on experience of the author's own research and on recourse to the literature and personal information. The carrying-out of tracer studies in manufacturing plants is described at some length, in order to give the reader unfamiliar with the methods an insight into the mode of procedure. The review is arranged in accordance with the process stages in the aluminium industry, from raw material to metal, and is primarily addressed to the practising technician. Some general comments are given regarding the use of radioisotopes in manufacturing plants and the process stages in modern aluminium production are described briefly. A subject index is included. (auth)

24636 (IAEA-R-310-F) RESEARCH WITHIN THE FRAMEWORK OF A COORDINATED PROGRAMME ON THE APPLICATION OF RADIATION TECHNIQUES TO WATER USE EFFICIENCY STUDIES. Final Report, March 1965–31 July 1970. El-Bissary, E. A.; Kandil, M. F.; Abd-El-Al, S. I.; El-Demerdashe, S.; Masoud, A. (International Atomic Energy Agency, Vienna (Austria)). Dec 1971. 22p. INIS.

The coordinated research program carried out simultaneously in a number of countries is reported. The main objectives of this program were set forth by the panel on "The Use of Isotope and Radiation Techniques in Soil Moisture and Irrigation Studies" held in Vienna in October 1964. Based on reliable evapotranspiration data obtained in the field under different irrigation regimes and different climatological conditions, the program aimed at increasing yields of the main field crops through making better use of the limited amounts of water available for irrigation. Another main objective was to test and compare the main approaches used in evapotranspiration studies. Under different irrigation regimes

evapotranspiration or evaporation data was obtained through daily weighing of hydraulic weighable lysimeters provided with a drainage system, having an area of 4 m^2 and a soil volume of approximately 7.2 m^3; by monitoring soil moisture changes in the lysimeters and in field plots with the aid of a neutron moisture meter; by recording meteorological data and computing the potential evaporation (E_0) after Penman; through measuring the evaporation from a Class A open pan. It took the soil with which the lysimeters were filled two years to settle and approach the conditions prevailing in the field. The potential evaporation estimated after Penman (E_0) was in good agreement with the actual evapotranspiration determined for the wet treatment with the aid of the weighable lysimeter for the season as a whole. The water use efficiency values should not be considered apart from the yields at which they were obtained as meaningless, rather high water use efficiency values could be associated with very low yields. Early planting of maize is advantageous as the higher yields obtained compensate for the greater water requirements. (INIS)

24637 (IAEA-R-311-F) RESEARCH WITHIN THE FRAMEWORK OF A COORDINATED PROGRAMME ON THE APPLICATION OF RADIATION TECHNIQUES TO WATER USE EFFICIENCY STUDIES. Final Report, 1 March 1965–31 December 1970. Macksoud, S. W. (International Atomic Energy Agency, Vienna (Austria)). Dec 1971. 21p. INIS.

The coordinated research program carried out simultaneously in a number of countries is reported. The main objectives of the program were set forth by the Panel on "The Use of Isotope and Radiation Techniques in Soil Moisture and Irrigation Studies" held in Vienna in October 1964. Based on reliable evapotranspiration data obtained in the field under different irrigation regimes and different climatological conditions, the program aimed at increasing yields of the main field crops through making better use of the limited amounts of water available for irrigation. Another main objective was to test and compare the main approaches used in evapotranspiration studies. Under different irrigation regimes evapotranspiration or evaporation data was obtained through daily weighing of hydraulic weighable lysimeters provided with a drainage system, having an area of 4 m^2 and a soil volume of ~7.2 m^3; by monitoring soil moisture changes in the lysimeters and in the field plots with the aid of a neutron moisture meter; by recording meteorological data and computing the potential evaporation (E_0) after Penman; and through measuring the evaporation from a Class A open pan. A maize crop was grown to maturity during 1966 and 1970. The results indicate that in general the lysimeters gave yields higher than those of the surrounding plots owing to the better aeration and the higher water holding capacity, associated with the lower bulk density prevailing in the lysimeters. The 1970 experiment shows low water use efficiencies, owing to the application of 400 mm of water invariably to all treatments during the first 62 days after planting. During the same period the water use indicated by the wet lysimeter was 326 mm, while the evaporation from a Class A open pan amounted to 335 mm and the potential evaporation estimated after Penman was 204 mm. Depending on the season and the treatment, the water use efficiency varied from 590 to 1160 g of maize grain per m^3 of water. (INIS)

24638 (IAEA-R-379-F) RESEARCH WITHIN THE FRAMEWORK OF A COORDINATED PROGRAMME ON THE APPLICATION OF RADIATION TECHNIQUES TO WATER USE EFFICIENCY STUDIES. Final Report, 15 December 1965–14 December 1970. Sharif, M. (International Atomic Energy Agency, Vienna (Austria)). Dec 1971. 59p. INIS.

The coordinated research program carried out simultaneously in a number of countries is reported. The main objectives of this program were set forth by the panel on "The Use of Isotope and Radiation Techniques in Soil Moisture and Irrigation Studies" held in Vienna in October 1964. Based on reliable evapotranspiration data obtained in the field under different irrigation regimes and different climatological conditions, the programme aimed at increasing yields of the main field crops through making better use of the limited amounts of water available for irrigation. Another main objective was to test and compare the main approaches used in evapotranspiration studies. Under different irrigation regimes evapotranspiration or evaporation data was obtained through daily weighing of hydraulic weighable lysimeters provided with a drainage system, having an area of 4m^2 and a soil volume of approximately 7.2 m^3; by monitoring soil moisture changes in the lysimeters and in field plots with the aid of a neutron moisture meter; by recording meteorological data and computing the potential evaporation (E_0) after Penman; and through measuring the evaporation from a Class A open pan. The maize crop was grown in 1968 and 1969. The total dry matter produced, the grain yield, and the weight of 1000 kernels all increased with the increase in the amounts of irrigation water applied. Throughout the study the yields were higher in the lysimeters than in the corresponding field plots. Evapotranspiration measurements performed with the hydraulic weighable lysimeters and with the neutron moisture meter were in very good agreement. The potential evaporation estimated after Penman (E_0) and the evaporation from a Class A pan for the 68 and 69 growth seasons gave very similar values. (INIS)

24639 (IAEA-R-664-F) GAMMA IRRADIATION OF SOME LOCAL FOODSTUFFS. Final Report, 1 January 1969–31 December 1972. Gonzales, O. N.; Dimaunahan, L. B.; Pilac, M.; Alabastro, V. Q. (International Atomic Energy Agency, Vienna (Austria)). Feb 1972. 11p. INIS.

Handling and storage practices of agricultural products under tropical conditions of the Philippines, induce sprouting and growth of moulds in tubers and root bulbs and cause insect infestation of grains and dried fruits. With the demonstration that ionizing radiation is effective for the preservation of food, investigations were undertaken to study effects of gamma irradiation from a cobalt-60 source on peanuts, onions, and ginger with relevance to the extension of their shelf-life. Packed shelled peanuts were irradiated at doses ranging from 0 to 150 Krads followed by their storage at room temperature for 10 months. In the case of onions and ginger, the products were separately packed and irradiated at doses of 0 to 15 Krad, and stored under a shed up to the time of their rotting. It was demonstrated that irradiation of peanuts at the doses administered did not affect the acceptability and the tributyric values of the product. The decrease in the microbial counts of the irradiated product was found to be proportional to the radiation dose given. It was shown that aflatoxin contamination was controlled at doses of 100 + 150 Krad during the 10 months storage period. Post-irradiation storage studies made on onions and ginger showed that irradiation doses of from 4 to 15 Krad inhibited sprouting in these crops. However, rotting was observed in both, non-treated and irradiated onions starting in the third month of post-irradiation storage. (INIS)

24640 (IAEA-R-781-F) GAMMA IRRADIATION OF SOME LOCAL SEA FOOD PRODUCTS. Final Report, 1 September 1969–31 December 1971. Pablo, I. S. (International Atomic Energy Agency, Vienna (Austria)). Feb 1972. 32p. INIS.

The lack of freezing and cold storage facilities in the Philippines renders fresh marine products very perishable at the high ambient temperatures in the country. For this reason, these products have to be dried, smoked or fermented in order to extend their shelf-life. However, the growth of yeasts and moulds on the dried and smoked products, renders them inferior in quality and unattractive to the consumers. The application of radiation-pasteurization of marine products to extend their shelf-life merits special studies. Dried species of plain croaker (Pseudoseiaena anea), striped mackerel (Restrelliger chrysozonus), long-finned mullet (Mugil caeruleomaculatus) and ribbon-finned nemipterid (Nemipterus taenipterus), and one shrimp species (Penaus specie) were gamma-irradiated from a cobalt-60 source after their packing in polyethylene bags. Following that, they were stored at 30 ± 1°C and 6 ± 2°C. Respective samples were periodically examined for bacterial contamination, yeasts and mould growth, spoilage and sensory evaluations. It was found that optimal irradiation doses of 0.05, 0.1, 0.1, 0.05, and 0.3 Mrad were adequate for the radiopasteurization of plain croaker, striped mackerel, long-finned mullet, ribbon-finned nemipterid and shrimp, respectively. At these doses a shelf-life extension of from 3 to 4 weeks was observed for fish and shrimp stored at 30 ± 1°C. The shelf-life of irradiated plain croaker and ribbon-finned mullet was extended by four weeks, and that of striped mackerel was extended by 14 weeks, when post-irradiated storage was at 6 ± 2°C. Irradiated samples were found to be of acceptable organoleptic characteristics. (INIS)

24641 (NP-19686) FIRST ACTIVITY REPORT, 1971. (International Project in the Field of Food Irradiation, Karlsruhe (West Germany)). 1971. 30p. Dep. NTIS (U. S. Sales Only) $3.50.

Progress during 1971 in preparing an internationally sponsored and conducted research program on the use of irradiation techniques for the preservation of food is reported. Twenty-one countries are participating. Contracts have been placed for wholesomeness testing of potatoes, wheat, and wheat products. Information is included on: the economic and technical feasibility of radiopreservation of food, wholesomeness of products; international collaboration; project organization; finances; contract procedures; and progress to date in potato and wheat studies. (LCL)

24642 (NVO-374-32) HAWAII FOOD IRRADIATION PROGRAM FOR THE PERIOD JANUARY 1, 1970 TO JUNE 30, 1972. (Hawaii State Dept. of Agriculture; Agricultural Research Service, Honolulu, Hawaii (USA). Fruit Fly Investigations Lab.). Feb 1973. 69p. Dep. NTIS $5.45.

A food irradiation program was undertaken to obtain raw data to support a petition to the FDA for using gamma irradiation for the commercial disinfestation of packaged papaya produced in Hawaii

and for using gamma radiation for improving the shelf life of fresh ginger root. Program activities from Jan. 1, 1970 to July 1, 1972 are reported. The data showed that: radiation treatment at a minimum absorbed dose of 25 krad prevents survival of 32 adult fruit flies from an infestation of one million eggs and larva, thus meeting the quarantine requirements; no undesirable changes in the chemical, physical, or sensory attributes of the fruit were induced; no changes in levels of reduced ascorbic acid were induced nor were peroxides detected in papaya fruit treated with ionizing radiation at maximum absorbed doses of 220 krad or less; the proposed disinfestation treatment is economically and commercially feasible; a 20 s 145°F hot water batch process treatment of the papaya prior to radiation disinfestation reduced chances of storage decay without injuring the fruit; commercial-type packaging in materials and package configurations compatible with radiation processing are satisfactory for the commercial handling and marketing of papaya; the marketable shelf-life of fresh ginger root grown in Hawaii can be improved significantly by radiation treatment at absorbed doses of less than 1 krad; and the same radiation plant used for disinfestation of papaya can be used to control sprouting of fresh ginger root. (LCL)

24643 VOLUMETRIC MEASURING METHOD AND APPARATUS. Joyce, W. B. (to Industrial Nucleonics Corp.). U. S. Patent 3,745,338. 10 Jul 1973. Filed date 17 Aug 1964. 16p.

Ullage volume of a container containing a fluid is determined by injecting a known quantity of radioactive material into the ullage volume. After the radioactive material has dispersed uniformly throughout the ullage volume the density thereof is measured to provide the ullage volume indication. The system can be utilized to monitor the amount of fuel in the container under either zero G or a gravitational field. The ullage volume indication can be compensated for pressure variations within the volume by utilizing a pressure transducer having an output that is combined with the detected density. A system is provided to compensate for background, radiation noise. The system can also be utilized to detect leakage from the container by noting changes in concentration of the radioactive material. Corrections for temperature variations are also provided. In fixed volumes systems, the device can be utilized to monitor pressure and temperature variations. (Official Gazette)

24644 STATE OF APPLICATION OF ^{252}Cf-NEUTRON SOURCES IN INDUSTRIAL PROCESS CONTROL AND WASTE WATER ANALYSIS. Specht, S. (Technische Univ., Munich). (1973). vp. (In German).

From conference of the Gesellschaft Deutscher Chemiker on trace analysis; Heidelberg, Germany (2 Apr 1973).

A survey is given of the application of portable neutron sources, primarily californium-252 sources, in industrial process control. The advantages of the ^{252}Cf source as compared with other sources are pointed out, special emphasis being placed on economy of operation. The methods and possibilities of on-stream application are discussed in brief and illustrated by several examples referring to integrated systems in industrial plants for the analysis of solid matter and foams (including ores, steel, cement, crude oil, etc.), further to the detection of nuclides in nuclear fuels and to the control of water quality. (INIS)

24645 STATUS AND PERSPECTIVES OF FOOD IRRADIATION. Goresline, H. E. pp 1-7 of Radiation Preservation of Food. Vienna; International Atomic Energy Agency (1973).

From international symposium on radiation preservation of food; Bombay, India (13 Nov 1972). See STI/PUB-317; CONF-721101-.

The status of the art is reviewed in broad terms; pointing out the advancements of research, the increase in number of research programs, the increase in number, size, and curie strength of pilot plants in the world, the development of international cooperation in the sharing of research results and information, the sharing of costs of wholesomeness testing, and the cooperation in solving radiation problems common to countries of a given area. The advancements made in research and development in the six years since the first international symposium on food irradiation are translated into perspectives of the future possibilities of use in the food industry of the world. The possible applications to the preservation of various food and feed products to meet the needs for extension of market life, the destruction of pathogenic microorganisms and parasites, and the production of shelf-stable products are pointed out. The economic viewpoint and the possibilities for use of irradiated products in international trade are discussed. The ancillary items to which immediate attention should be directed in order to ensure the reality of implementation of the irradiation process into industry and trade are discussed, such as new varieties of agricultural products, packaging, storage, transportation, labelling, consumer information, legal aspects, clearance of irradiated foods for human consumption for local use and clearance for exportable products in receiving countries. (auth)

24646 STATUS OF US DEPARTMENT OF AGRICULTURE RESEARCH ON IRRADIATION DISINFESTATION OF GRAIN AND GRAIN PRODUCTS. Tilton, E. W.; Brower, J. H. (Agricultural Research Service, Savannah, GA). pp 295-309 of Radiation Preservation of Food. Vienna; International Atomic Energy Agency (1973).

From international symposium on radiation preservation of food; Bombay, India (13 Nov 1972). See STI/PUB-317; CONF-721101-.

A ^{60}Co irradiator with a 26,000 Ci source constructed by the Atomic Energy Commission at the US Department of Agriculture's Stored-Product Insects Research and Development Laboratory, Savannah, Georgia, is capable of treating from 1 to 5 metric tons of grain or 1 metric ton of packaged products per hour. Extensive tests proved that doses below 50 krad controlled insects in bulk wheat, wheat flour, cornmeal, peanuts (shelled and inshell), tree nuts and dried fruits. Also, control of infesting insects can be obtained in dried beans, rice and a wide variety of packaged products. Combinations of adjunctive treatments (infrared or microwave heating) with gamma radiation evaluated in an attempt to lower the cost of disinfestation by irradiation demonstrated that both combinations produced excellent results. Because of ease of handling and the lower cost of operation, infrared heating of gamma-irradiated grain seems more promising. No resistance developed in any of four species of insects exposed to substerilizing levels of irradiation for 30 generations. Also, two malathion-resistant strains of Indian meal moths, Plodia interpunctella (Hübner), showed normal susceptibility to gamma irradiation. Preliminary tests are underway to evaluate the sterile-male technique for the control of the Indian meal moth. An adaptation of the classic technique that makes it more applicable to Lepidoptera has been developed at this laboratory. (auth)

24647 SOME OBSERVATIONS REGARDING IRRADIATED WHEAT. Pape, G. (National Committee on Nuclear Energy, Rio de Janeiro). pp 311-338 of Radiation Preservation of Food. Vienna; International Atomic Energy Agency (1973).

From international symposium on radiation preservation of food; Bombay, India (13 Nov 1972). See STI/PUB-317; CONF-721101-.

The insects that mainly infest stored wheat and wheat products are surveyed and described. With a view to the potential use of ionizing radiation in destroying such pests, a study was undertaken of the effect of gamma rays on such products. The radiation was obtained from ^{60}Co and ^{137}Cs sources. Doses assayed were 5, 10, and 50 krad, along with occasional superexposures (600 and 1290 krad). Chemical and physical analyses were performed immediately after irradiation and after varying intervals of time, during which the products were stored at room temperature. Results are presented and their significance discussed. Taking into account the main use of wheat, special importance was given to baking tests. Included is a general appraisal of the situation of wheat and wheat flour in Brazil, with respect to infestation by insect pests. (auth)

24648 ATTEMPTS TOWARD COMMERCIALIZATION OF FOOD IRRADIATION IN THE FEDERAL REPUBLIC OF GERMANY. Gruenewald, T. (Inst. of Irradiation Tech., Karlsruhe, Ger.). pp 367-373 of Radiation Preservation of Food. Vienna; International Atomic Energy Agency (1973).

From international symposium on radiation preservation of food; Bombay, India (13 Nov 1972). See STI/PUB-317; CONF-721101-.

First steps have been taken in the Federal Republic of Germany to achieve commercialization of food irradiation. The government has given permission for the industrial processing of various varieties of potatoes to produce chips, cooked, french fried, and dehydrated potatoes in limited quantities. Several companies have tested the method and consumer tests have demonstrated the quality of the products. The fishing industry has presented to the Government a petition for the on-board irradiation of fresh fish. An irradiation facility (x-ray source) has been installed aboard a research ship and the effectiveness of the radiation process can now be tested under practical conditions. The purpose of on-board irradiation is to obtain a longer shelf-life for iced fish and thus to gain time for better utilization of the fishing vessel and for improved marketing of fresh fish in the inland regions of the country. The German Ministry of Health has given limited permission to a hospital to serve radiation-sterilized deep-frozen ready-prepared meals to patients in intensive-care wards. (auth)

24649 TOLERANCE, QUALITY, AND SHELF-LIFE OF GAMMA IRRADIATED PAPAYA GROWN IN HAWAII, TAIWAN, AND VENEZUELA. Moy, J. H. (Univ. of Hawaii, Honolulu); Akamine, E. K.; Wenkam, N.; Dollar, A. M.; Hanaoka, M.; Kao, H. Y.; Liu, W. L.; Revetti, L. M. pp 375-387 of Radiation Preservation of Food. Vienna; International Atomic Energy Agency (1973).

From international symposium on radiation preservation of food; Bombay, India (13 Nov 1972). See STI/PUB-317; CONF-721101-.

Papaya (Carica papaya L.) and other tropical fruits grown in the tropics and subtropics are subject to fruit-fly infestation. Earlier studies by the Hawaii Fruit Fly Investigations Laboratory of the US Department of Agriculture have shown that treatment of Hawaii-grown fresh papaya and other tropical fruits with gamma-radiation at 21 krad and above would prevent development of 3 species of eggs and larvae into adult fruit flies in infested fruits. This low-dose treatment, based on further research in Hawaii, was well below the tolerance dose of the papaya, which could retain its chemical, nutritional, and sensory qualities. Shelf-life of the Hawaii-grown papaya (var. Solo) could be extended 3 to 3½ days when treated with hot water (49°C, 20 min) and 75 krad. Research and shipping studies by co-operative agencies in Hawaii from 1964–1971 have culminated in the preparation of a petition to be submitted by USAEC to USFDA for the approval of the use of gamma radiation to treat papaya as a quarantine measure. To determine this potential application of atomic energy, a comparative study was made on the effect of low-dose gamma radiation on the tolerance, quality retention and shelf-life of papayas grown in Hawaii, Taiwan and Venezuela. (auth)

24650 RADIATION PRESERVATION OF SEAFOODS: REVIEW OF RESEARCH IN INDIA. Kumta, U. S.; Savagaon, K. A.; Ghadi, S. V.; Doke, S. N.; Gore, M. S.; Venugopal, V.; Madhavan, V. N.; Sreenivasan, A. (Bhabha Atomic Research Centre, Bombay). pp 403–425 of Radiation Preservation of Food. Vienna; International Atomic Energy Agency (1973).

From international symposium on radiation preservation of food; Bombay, India (13 Nov 1972). See STI/PUB-317; CONF-721101-.

Research and development programs on radiation preservation of seafoods being carried out at this Research Centre aim at developing processes for the preservation of tropical fishery products of economic significance and improving their quality and shelf-life at refrigerated or ambient temperatures to enable wider distribution. Radiation processes for extending the shelf-life of shrimp (Penaeus indicus and Metapenaeus affinus), Bombay duck (Harpodon nehereus) and white pomfret (Stomateus cinereus) have been developed for refrigeration (0 to 4°C) and ambient (25 to 32°C) storage temperatures. The amenability of medium fatty fishes such as pomfrets (Stomateus cinereus, Parastomateus niger), salmon (Eleutheronesma tetradactylum) and mackerel (Rastrelliger kanagurta) to radurization processes has been demonstrated. The storage properties of radurized tropical fishery products have been evaluated in terms of microbiological, chemical and sensory indices of freshness. Conditions for minimizing oxidative rancidity leading to yellow discoloration in white pomfret and for stabilizing myoglobin in white and dark muscle tissues of black pomfret and Indian salmon have been investigated. Promising processes have been scaled up and limited shipment studies have been conducted. (auth)

24651 PRESERVATION OF FISHERY PRODUCTS BY IONIZING RADIATION WITH SPECIAL REFERENCE TO BOILED CHUB MACKEREL. Loaharanu, P.; Srisara, B.; Nouchpramul, K.; Prompubesara, C.; Kraisorn, K. (Office of Atomic Energy for Peace, Bangkok). pp 427–440 of Radiation Preservation of Food. Vienna; International Atomic Energy Agency (1973).

From international symposium on radiation preservation of food; Bombay, India (13 Nov 1972). See STI/PUB-317; CONF-721101-.

The effect of irradiation at doses of 0.1, 0.2 or 0.3 Mrad in extending the storage life of boiled chub mackerel held at room temperature is described. Total aerobic count and the content trimethylamine nitrogen and total volatile basic nitrogen were used as objective indices of quality in comparison with sensory evaluation of the product. Boiled fish irradiated at 0.1, 0.2 or 0.3 Mrad were found to be of good quality for 10, 15 and 17 days respectively, compared with 3 days for the non-irradiated control. Trimethylamine nitrogen and total volatile basic nitrogen contents were found to be useful indices of quality, showing fair correlation with sensory evaluation of the irradiated product. Total aerobic count showed little value as a quality index. Bacillus, Staphylococcus and Micrococcus predominated in both non-irradiated and irradiated boiled fish. The product was found to be free of faecal coliform. Safety of the irradiated boiled fish with regard to botulism is discussed. Boiled chub mackerel irradiated at 0.2 and 0.3 Mrad were transported by freight train to Chieng Mai and Udorndhani, distances of 800 km North and 650 km Northeast of Bangkok respectively. Consumer acceptance of the irradiated boiled fish was conducted using a nine-point hedonic scale in comparison with non-irradiated boiled fish. Boiled fish subjected to 0.2 and 0.3 Mrad were superior in quality to the non-irradiated counterpart. The irradiated boiled fish had a minimum market life of 4 days at the points of sale in inland markets, whereas the market life of the non-irradiated fish was only one day. A dose of 0.2 Mrad would be adequate for commercial irradiation of boiled fish. (auth)

24652 SHIPBOARD IRRADIATION OF SHRIMP. Novak, A. F.; Rao, M. R. R. (Louisiana State Univ., Baton Rouge). pp 441–455 of Radiation Preservation of Food. Vienna; International Atomic Energy Agency (1973).

From international symposium on radiation preservation of food; Bombay, India (13 Nov 1972). See STI/PUB-317; CONF-721101-.

An investigation was designed to evaluate the feasibility of low-dose gamma-radiation processing of shrimp at sea with a portable on-shipboard irradiator installed aboard the US Bureau of Commercial Fisheries research vessel "Oregon". Irradiation, handling, storage and transportation procedures were developed that were compatible with the nature of the product. After irradiation and iced-storage aboard ship, the shrimp were transported to the Louisiana State University Department of Food Sciences Laboratories for chemical, physical, microbiological and organoleptic testing. Results demonstrated the on-shipboard irradiated shrimp to be superior to shrimp irradiated after iced-storage of 4 days, and to the non-irradiated, iced-stored control. The on-shipboard irradiator was later removed from the "Oregon" and relocated at a dockside site in Grand Isle, Louisiana. Shrimp were purchased through commercial channels from shrimpers who could ascertain that the product was not more than 5 h out of the water. These shrimp were packaged, irradiated immediately and returned to the Department of Food Science for subsequent testing. Results indicated that dockside irradiated shrimp, while lower in overall quality than on-shipboard irradiated shrimp, as measured by laboratory and sensory methods, are superior in these attributes and remain palatable longer under iced-storage than shrimp receiving no radiation treatment. (auth)

24653 RADAPPERTIZATION OF MEAT, MEAT PRODUCTS, AND POULTRY. Josephson, E. S.; Brynjolfsson, A.; Wierbicki, E.; Rowley, D. B.; Merritt, C. Jr.; Baker, R. W.; Killoran, J. J.; Thomas, M. H. (Army Natick Labs., MA). pp 471–490 of Radiation Preservation of Food. Vienna; International Atomic Energy Agency (1973).

From international symposium on radiation preservation of food; Bombay, India (13 Nov 1972). See STI/PUB-317; CONF-721101-.

Significant improvements have been made during the past six years in the quality and acceptance of a broad spectrum of thermally enzyme inactivated vacuum packaged meat, meat products, poultry, and seafood radappertized according to the 12-D concept for microbiological safety by exposure to ^{60}Co gamma rays or electrons from an electron linear accelerator. These improvements resulted from (1) irradiating the foods while frozen and held in the temperature range from –45 to –5°C; (2) controlling the vacuum in the packages; (3) adding small amounts of sodium tripolyphosphate (0.4%) and sodium chloride (0.7%) to improve juiciness; (4) selecting flexible packaging materials and enamel can liners, which are better adapted to withstand the challenges of irradiation at low temperatures and subsequent storage without refrigeration for at least two years; and (5) improving the electron linear accelerator so that it has become a reliable radiation source for the radappertization process. Radappertized beef, chicken, ham, pork, pork sausage, corned beef, bacon, ground beef (hamburger), turkey, salami and codfish cakes consistently scored well in the acceptance range when evaluated by expert and consumer taste-test panels and when served as components of experimental meals even after storage for more than two years at uncontrolled temperatures ranging according to the season from 21°C to approximately 38°C. Similar results were obtained for radappertized shrimp after 9 months' storage without refrigeration. The most recent advances in radappertization processing of meat, meat products, poultry and seafood with particular emphasis upon technology, packaging, microbiology, dosimetry, acceptance, flavour chemistry, wholesomeness and nutritional quality are presented. (auth)

24654 LOW-DOSE RADIATION PRESERVATION OF RETAIL CUTS OF MEAT. Urbain, W. M. (Michigan State Univ., East Lansing). pp 505–521 of Radiation Preservation of Food. Vienna; International Atomic Energy Agency (1973).

From international symposium on radiation preservation of food; Bombay, India (13 Nov 1972). See STI/PUB-317; CONF-721101-.

Fresh meat is highly perishable, especially when cut into retail units, and even with good refrigeration has a life of only a few days. A number of investigators have shown that low doses of ionizing radiation (below the threshold dose of detectable off-flavor development, i.e., about 250 krad) can delay microbial spoilage. Control of microbial spoilage, however, is not sufficient. Dis-

colorations and the weepage of fluid are not controlled by irradiation and they greatly affect salability and consumer acceptance. For control of these other deteriorative processes, the use of condensed phosphates plus a double packaging system that provides anaerobic conditions during most of the storage period and aerobic conditions only in the latter part have been found effective. At about 3°C retail cuts of meat have been kept for approximately three weeks in a satisfactory condition with respect to microbial status, color, and weepage. This period is sufficient to permit centralization of the cutting and packaging operations now carried out in the retail store. The ultimate microbial outgrowth pattern is changed from one largely in which Pseudomonads predominate to one primarily of lactic acid organisms. The effect of dose rates from 0.05 to 50 krad/s on the lean color of beef was studied. Fat oxidation was not related to irradiation, but did occur to a small degree under aerobic conditions. (auth)

24655 APPLICATION OF THE ETHANOL-CHLOROBENZENE DOSIMETER TO ELECTRON-BEAM AND GAMMA-RADIATION DOSIMETRY. III. Tissue-Equivalent Dosimetry. Razem, D.; Dvornik, I. (Inst. Rujer Boskovic, Zagreb). pp 537-547 of Radiation Preservation of Food. Vienna; International Atomic Energy Agency (1973).

From international symposium on radiation preservation of food; Bombay, India (13 Nov 1972). See STI/PUB-317; CONF-721101-.

A new family of liquid chemical dosimetric systems consisting of ethanolic solutions of chlorobenzene and yielding HCl upon irradiation is proposed for high-level routine measurements. The systems offer the possibility of tissue-equivalent dosimetry through the use of dosimetric solutions with various chlorobenzene concentrations. G(HCl) values dose-insensitive between 0.1 and 10 Mrad have been obtained by partial evacuation of the systems before sealing. Favorable absorption characteristics, simple preparation, insensitivity to impurities, long-term stability, low cost and very good reproducibility make the system superior to the aqueous chemical dosimetric systems operative in this dose range. (auth)

24656 DEFINITION AND CONTROL OF PROCESSING PARAMETERS FOR RADAPPERTIZATION OF BEEF FOR WHOLESOMENESS STUDIES IN THE UNITED STATES OF AMERICA. Brynjolfsson, A. (Army Natick Labs., MA). pp 549-560 of Radiation Preservation of Food. Vienna; International Atomic Energy Agency (1973).

From international symposium on radiation preservation of food; Bombay, India (13 Nov 1972). See STI/PUB-317; CONF-721101-.

The processing parameters for radappertization of beef with gamma rays from ^{60}Co and with electrons from a 10-MeV linear accelerator must be definable, measurable and controllable in such a way that the health authorities can regulate the process and the industry must be able to set up practical procedures that fulfill the intent and the requirements of the regulations. Standards for use in regulating and licensing the operation of a radiation facility for food processing are suggested. The definition of dose, the dose distribution, the accuracy of the dose measurements, as well as the significance of the accuracy of the dose measurements for regulation of definite D-values for microbial reduction are discussed in the light of experience gained from radappertization processing of the beef with gamma rays from ^{60}Co and electrons from 10-MeV linear accelerators. The changes in temperature of the product during irradiation with radappertizing doses are illustrated to show the limitation and accuracy of the temperature measurements in actual processing. Marking of the product and control of the product flow used in processing of the beef for the wholesomeness studies are given as examples of how to manage and regulate industrial processing controls. (auth)

24657 OPTIMIZATION OF THE IRRADIATION DISINFESTATION FACILITY FOR MILLET, SORGHUM, AND NIEBE AT THE SO.TRA.MIL. PILOT PLANT AT ZINDER (NIGER). Foulani, P. (CEA, Grenoble, France). pp 563-575 of Radiation Preservation of Food. Vienna; International Atomic Energy Agency (1973). (In French).

From international symposium on radiation preservation of food; Bombay, India (13 Nov 1972). See STI/PUB-317; CONF-721101-.

The general aspects of conservation of foodstuffs by gamma irradiation and the design of industrial irradiators intended for this purpose (prototype irradiators, calculations, radiation technology, etc.) were studied. The construction of a grain irradiator for the disinfestation of millet, sorghum and niébé at the SO.TRA.MIL. pilot plant at Zinder (Republic of Niger) is described. (auth)

24658 IRRADIATION OF FOODSTUFFS IN BAGS. Brouqui, M. (CEA, Grenoble, France); Eymery, R.; Saint-Lebe, L. pp 577-591 of Radiation Preservation of Food. Vienna; International Atomic Energy Agency (1973). (In French).

From international symposium on radiation preservation of food; Bombay, India (13 Nov 1972). See STI/PUB-317; CONF-721101-.

The close co-operation between biologists and irradiation facility experts at the French Commissariat à l'Energie Atomique should find its expression in the putting into service at the Cadarache Nuclear Research Centre (France) (probably in 1973) of a pilot irradiator intended for the treatment of industrial maize starch packed in paper bags with a unit capacity of 50 kg. The overall design of this facility, which is normally intended for irradiating 10 tons of starch per day at a dose of 250 ± 25 krad, with the possibility of increasing the daily output to 40 tons, is the outcome of a series of decisions, for which the reasons are set forth in the paper. In particular, it is shown that the packaging of the commodity to be treated and the manner in which the source is arranged when out of use play an important role in determining the type of conveyor for transporting the sacks, account also being taken of economic factors and of operational safety requirements. (auth)

24659 COST CONSIDERATIONS FOR THE ESTABLISHMENT AND OPERATION OF A COMMERCIAL FOOD IRRADIATION FACILITY. Deitch, J. (Bureau of Domestic Commerce, Washington, DC). pp 593-615 of Radiation Preservation of Food. Vienna; International Atomic Energy Agency (1973).

From international symposium on radiation preservation of food; Bombay, India (13 Nov 1972). See STI/PUB-317; CONF-721101-.

The United States of America has a number of food irradiation facilities used primarily for conducting product research. However, none of these are designed to provide reliable data on operating costs for food irradiation at commercial levels. Consequently, one must rely on estimates to gain a realistic insight into the economics and potentials of food irradiation as a major competitive process in the preservation of foods. Those elements that must be considered that will determine the feasibility of ionizing radiation as a commercial process for the preservation of food are identified and examined. They are: (1) the characteristics of the products to be processed; (2) the characteristics of the facility; (3) types of energy sources, their characteristics and usage; (4) methods of financing; and (5) investment requirements and provisions for return on investment. Product and facility variations and differences are described with an explanation of their effect on the cost of operations. The cost of the energy source, isotope or electron accelerator, is considered on the basis of installation cost, cost of utilization, source reliability, and methods of computing depreciation. Estimated costs of operation are developed for each type of source, ^{60}Co, ^{137}Cs and electron accelerator, by cost per Curie, efficiency of utilization, power output and hours of operation (plant utilization). Highly significant in the determination of costs and related prices is an understanding of financing a new and untried technology and the capital investment required. The amortization of investment and return on owner's equity (profit), interest on funds borrowed to finance investment, and taxes must all be considered in pricing the new irradiated product. The capital required will depend mainly upon four factors: (1) research, planning, design and engineering; (2) scale of operation; (3) type of source; (4) type of operation, i.e., (a) service on a fee basis, (b) irradiating foods for resale, or (c) irradiation integrated in a food processing facility. (auth)

24660 COMMERCIAL DISINFESTATION TREATMENT OF FRUIT BY IONIZING RADIATION. Dollar, A. M.; Hanaoka, M. (Hawaii Dept. of Agriculture, Honolulu). pp 617-628 of Radiation Preservation of Food. Vienna; International Atomic Energy Agency (1973).

From international symposium on radiation preservation of food; Bombay, India (13 Nov 1972). See STI/PUB-317; CONF-721101-.

The normal commercial carton packed with papayas or mangoes has a bulk density in the range of 0.20 to 0.43 g/cm^3 and a maximum to minimum absorbed dose ratio of less than 1.5. As many as 27 dosimeters are positioned in packages both within the product and at the surfaces of the carton to ensure that maximum and minimum dose regions are adequately monitored. The maximum dose rate position above or below the source modules, which depends on source to product distance, is more than 300 krad/h. Normally, process cycle timing is monitored and recorded by an event recorder, which has a precision of 1%. The recommended commercial treatment sequence is: (1) treat by washing with high temperature water (60°C) for a short exposure time (20 s); (2) dry for 20 s; (3) grading and sizing; (4) pack 5 kg net weight in a fibreboard carton; (5) seal cartons with tape to ensure an insect-proof container; (6) treat with gamma radiation at the approved minimum absorbed dose (greater than 25 krad); and (7) load for transport or

store at 10 ± 4°C. The high-temperature, short-time hot-water treatment was developed by fitting tolerance data to a modified Arrhenius plot to relate time and temperature conditions that would injure the fruit by inactivating enzymes and would control surface spoilage organisms. The adoption of high temperatures and short times reduces in-process delays in effect increasing distribution life. When the treatment is combined with radiation treatment at a maximum absorbed dose of 75 krad the distribution life is increased significantly. This higher temperature hot-water treatment is suitable for continuous processing, reduces the volume of water required for treatment and minimizes the survival of spoilage organisms in the recycled water. (auth)

24661 FACTORS INFLUENCING FOOD IRRADIATION ECONOMICS. Gard, C. W. S.; Warland, H. M. F. (Atomic Energy of Canada Ltd., Ottawa). pp 629-636 of Radiation Preservation of Food. Vienna; International Atomic Energy Agency (1973).

From international symposium on radiation preservation of food; Bombay, India (13 Nov 1972). See STI/PUB-317; CONF-721101-.

The factors that affect the economics of food irradiation with ^{60}Co are illustrated using irradiation costs for two types of irradiators. One irradiator is designed for processing a large volume of product to a low dose. The other irradiator is for a smaller throughput at an intermediate dose. (auth)

24662 FOOD IRRADIATION RESEARCH IN BANGLADESH. Chowdhury, M. S. U.; Rahman, A. T. M. F. (Atomic Energy Centre, Dacca, Bangladesh). pp 637-645 of Radiation Preservation of Food. Vienna; International Atomic Energy Agency (1973).

From international symposium on radiation preservation of food; Bombay, India (13 Nov 1972). See STI/PUB-317; CONF-721101-.

Some results of efforts made in Bangladesh in the field of food irradiation are outlined. The irradiation dose for complete elimination of stored grain pests within 3 to 4 weeks of irradiation fell in the range of 10 to 25 krad, 16 krad being an effective dose for disinfestation. Some fungal species responsible for the deteriorating quality of stored rice were identified and their lethal doses fell between 195 and 225 krad. Physical, organoleptic and rat-feeding tests on irradiated rice showed no harmful effect. The irradiation of bananas before the onset of the climateric extended their shelf-life by 9 to 11 d and there were definite differences in the spoilage patterns of non-irradiated and irradiated bananas. Very limited success was obtained in the extension of the shelf-life of pineapples, while mango-juice irradiation combined with heating showed promise. Irradiation of potatoes and onions at 8 to 10 krad and 6 to 8 krad respectively inhibited sprouting, and substantially reduced weight loss and rot incidence. These items are awaiting experiments on pilot-scale irradiation and bulk-storage studies. Preliminary studies on the preservation of fish by irradiation show promise. Volatile acid number (VAN) was found to serve as a reliable index for freshness; trimethylamine nitrogen (TMA) proved unreliable. (auth)

24663 INTERNATIONAL CO-OPERATION IN THE FIELD OF FOOD IRRADIATION. Potter, W. T. (OECD Nuclear Energy Agency, Paris). pp 647-656 of Radiation Preservation of Food. Vienna; International Atomic Energy Agency (1973).

From international symposium on radiation preservation of food; Bombay, India (13 Nov 1972). See STI/PUB-317; CONF-721101-.

Given the serious problem of feeding the world population, any economically viable process that will increase the supply of wholesome food deserves careful consideration. Irradiation has been shown to be a promising treatment for perishable foods but the process tends to be regarded with suspicion and in most countries is subject to strict control by law. It is, therefore, a particularly appropriate subject for study at the international level. Objective scientific evidence is required to enable the health authorities to make an informed judgement on whether irradiated food may be accepted for human consumption. Under the sponsorship of the OECD Nuclear Energy Agency (NEA), the International Atomic Energy Agency (IAEA) and the Food and Agriculture Organization of the United Nations (FAO) an International Project in the Field of Food Irradiation was established Jan. 1, 1971 to undertake investigations into the wholesomeness of irradiated foodstuffs. At present 21 countries are participating in the Project. The background and objectives of the Project and the wider problems arising from food irradiation that must be received at international level are outlined. (auth)

24664 PROSPECTS FOR FOOD IRRADIATION IN THE UNITED KINGDOM. Stott, A. N. B. (Atomic Energy Research Establishment, Harwell, Eng.). pp 743-752 of Radiation Preservation of Food. Vienna; International Atomic Energy Agency (1973).

From international symposium on radiation preservation of food; Bombay, India (13 Nov 1972). See STI/PUB-317; CONF-721101-.

The present position in the United Kingdom with regard to food irradiation is dealt with. As in most other countries strict legislative requirements must be met before irradiated food can be sold for public consumption. The process of preparation and submission of a petition for exemption from the UK regulations is outlined and the progress of the first such petition is described. A number of factors will be critical in determining the success of such petitions. The most important are: (1) the way in which experimental evidence in relation to wholesomeness meets the criteria of the approving body. Evidence is produced in relation to the first condition to show that with the increasing stringency of legislation experimental evidence may always fall short of requirement, particularly with the slow "food-by-food" clearance strategy; and (2) the recognition by the approving body that there exists a demand for the new process. A plea is made for a more realistic approach to the balance of risk and benefit. (auth)

24665 STATUS OF PUBLIC HEALTH ACCEPTANCE OF IRRADIATED FOOD IN THE NETHERLANDS. de Zeeuw, D.; van Kooij, J. G. (Instituut voor Toepassing van Atomenergie in de Landbow, Wageningen, Netherlands). pp 753-760 of Radiation Preservation of Food. Vienna; International Atomic Energy Agency (1973).

From international symposium on radiation preservation of food; Bombay, India (13 Nov 1972). See STI/PUB/317; CONF-721101-.

Wholesomeness testing of both irradiated individual food items and irradiated complete diets was carried out in the Netherlands. On the basis of the data acquired, a number of food items have been authorized either for experimental batches (i.e., strawberries, asparagus) or in unlimited amounts (potatoes, mushrooms, wheat, etc.). Authorization is expected to be given in 1973 for chicken and spices, while authorization of the process will be considered after completion of larger-scale pig experiments (around 1975). (auth)

24666 ENGINE OIL INSPECTION SYSTEM USING X-RAY FLUORESCENCE. Packer, L. L.; Bruton, W. A.; Woody, B. A. (to United Aircraft Corp.). U. S. Patent 3,751,661. 7 Aug 1973. Filed date 10 Jun 1970. 8p.

The concentration of metal wear particles in the lubricating oil system of engines such as aircraft gas turbines is continuously monitored by using x-ray fluorescent techniques. A beta excited x-ray source such as ^{147}Pm is mounted in a novel annular apposition target arrangement, and supplies primary x-rays to circulating engine oil. Depending on the source and target composition, selected metals such as iron in the oil will emit secondary fluorescent radiation which is measured by a lithium-drifted silicon semiconductor detector. Concentrations of metals as low as 2 parts per million may be detected. (Official Gazette)

24667 TIMEPIECE COMPRISING A NUCLEAR POWER SOURCE. Adler, K.; Ducommun, G. (to Biviator S. A.). U. S. Patent 3,740,941. 26 Jun 1973. Priority date 23 Feb 1970, Switzerland. 2p.

A timepiece comprising a nuclear isotopic power source enclosed in a calotte sealed by a cover is described. A protecting plate is disposed at a distance from said cover, and at least a part of the mechanism of the timepiece is accommodated in the space between said cover and said protecting plate. (Official Gazette)

24668 NUCLEAR-PACED SOLID STATE WRISTWATCH. Bergey, J. M. (to HMW Industries, Inc.). U. S. Patent 3,724,201. 3 Apr 1973. Filed date 27 Jan 1971. 16p.

A solid state wristwatch incorporating a nuclear timing source is described. A radioisotope such as ^{226}Ra decays, producing alpha particles that are detected and converted into electrical pulses of constant frequency. The electrical signals are divided in a CMOS binary chain and used to drive a digital time display of light emitting diodes. The watch is powered by a conventional 3 volt battery. (Official Gazette)

24669 RADIOAKTIVNYE IZOTOPY V STALEPLAVIL'NYKH PROTSESSAKH. (Radioisotopes in Steel Smelting Processes). Skrebtsov, A. M. Moscow; Izdatel'stvo Metallurgiya (1972). 304p.

The results of domestic and foreign studies on steel manufacturing processes using radioisotopes were systematized and generalized. For the first time the experimental data of different authors were subjected to a mathematical processing. The possibility of increasing the productivity of steel smelting assemblies and improvement of the quality of the steel is discussed. The results of industrial studies of the hydrodynamics of liquid metals

and slags, the kinetics of slag formation processes, smelting of scraps, interaction of metallic melts with slags and refractory linings of vats, abrasion of refractory materials, etc. were examined. (tr-auth)

24670 STATE OF THE APPLICATION OF ^{252}Cf NEUTRON SOURCES TO INDUSTRIAL PROCESS CONTROL. Specht, S. (Technische Univ., Munich). Atomwirt., Atomtech.; 18: No. 6, 306-311(1973). (In German).

Industrial process control and monitoring represent the greatest potential for activation analysis and related techniques using portable neutron sources. In comparing the most important neutron sources using radionuclides, californium-252 merits particular attention because of its high specific neutron activity, its approximation to a point source, its low heat and helium release as well as its acceptable gamma emission and half life. The most important applications published in the last few years for the on-stream analysis of solids and sludges are classified under the various neutron sources. (GE)

24671 RADIOACTIVE LIGHTNING CONDUCTOR. (to Societe des Procedes de Protections Electriques G. Messien). French Patent 2,132,958. 2 Apr 1971. 3p. (In French).

Radioactive lightning conductors are described, which are provided with an ionizing volume containing radioactive elements in the form of pellets made of ceramic material containing one or more radioactive substances. The pellet is housed in a capsule provided with a fixing tail part which is slightly conical or drawn out. (FR)

24672 SAFETY PROBLEMS IN CONDUCTING RADIATION-CHEMICAL PROCESSES. Larichev, A. V. Zh. Vses. Khim. Obshchest. im. D. I. Mendeleeva; 18: No. 3, 327-332(1973). (In Russian).

In carrying out radiation chemical processes, there exists principally a possibility of injuries affecting the operating personnel by radiation and related factors. The characteristics of the sources of ionizing radiation used in radiation chemistry, their characteristic factors of radiation safety, and the state of the art of assuring safety of the personnel handling various sources of radiation are reviewed. (32 references) (JPRS)

24673 RADIATION VULCANIZATION AND MODIFICATION OF RUBBERS. Kuz'minskii, A. S.; Fedoseeva, T. S.; Makhlis, F. A. Zh. Vses. Khim. Obshchest. im. D. I. Mendeleeva; 18: No. 3, 285-293(1973). (In Russian).

A review of the contemporary state of the problem of practical utilization of ionizing radiation in the rubber industry is presented. A detailed analysis is carried out of the physicochemical, technological and economical aspects of the problem. The feasibility and desirability of carrying out radiation modification of rubber materials by means of grafted polymerization of polyfunctional compounds from the liquid phase have been demonstrated. Optical doses have been decreased and the properties of radiation vulcanizates have been improved. (54 references) (JPRS)

LIFE SCIENCES

Radiation Effects on Biochemicals

Refer also to abstracts 24259, 24276, 24703, 24704, 24720, 24744, 24745, 24792, and 24829.

24674 (TID-26372) CELLULAR PROLIFERATION AND REGENERATION FOLLOWING TISSUE DAMAGE. Final Report. Harding, C. V. (Oakland Univ., Rochester, Mich. (USA)). Jun 1973. Contract AT(11-1)-1427. 7p. Dep. NTIS $3.00.

Results obtained in the 8-yr research period on effects of x radiation on healing of crystalline lens are summarized and 39 publications resulting from the project are listed. (MCG)

24675 (UCLA-12-919) ANNUAL PROGRESS REPORT FOR THE PERIOD ENDING JUNE 30, 1973. (California Univ., Los Angeles. Lab. of Nuclear Medicine and Radiation Biology). 1973. Contract AT(04-1)-GEN-12. 153p. Dep. NTIS $7.60.

Separate announcements and indexing were prepared for each of the 29 sections grouped under the categories biochemistry, developmental biology, environmental biology, nuclear medicine, radiation measurements, and radiobiology. (MCG)

For abstracts of individual sections see: 24081, 24258–24260, 24470, 24514, 24676, 24689, 24738, 24810, 24811, 24847, 24858–24862, 24893–24895, and 26927–26935.

24676 (UCLA-12-919, pp 117-120) RADIATION BIOCHEMISTRY OF NUCLEIC ACIDS AND THEIR CONSTITUENTS. 1973.

In annual progress report for the period ending June 30, 1973.

Studies on radiolysis of DNA in aqueous solution showed that the production of radioinduced strand breaks was linear with dose. In vitro studies on γ-radioinduced strand breaks in DNA showed that the yield of strand breaks doubled on post-irradiation incubation for two hrs. Models were developed for studying mechanisms of γ-radioinduced strand breakage in DNA. (HLW)

24677 ALL-OR-NOTHING CHARACTER OF DNA DEGRADATION IN BACTERIA AFTER IONIZING RADIATION. Pollard, E. C.; Kraus, K. (Pennsylvania State Univ., University Park). Contract AT(11-1)-3411. Biophys. J.; 13: No. 4, 332-339(Apr 1973).

The response of single cells of Escherichia coli B_{s-11} and 15JG151 to radioinduced DNA degradation was observed by autoradiography. For both cells it is concluded that the event that causes DNA degradation is of an all-or-nothing character. The unit that suffers degradation is not the whole cell, but each cell has between two and four such units. The results suggest that there is some resynthesis of degraded DNA. Evidence that this occurs is shown by examining the degradation of mass cultures of 15TAU/t3 and t7 below and above the permissive temperature for DNA synthesis. The results on the all-or-nothing character are in agreement with previous studies made by completely different techniques. (auth)

24678 INFLUENCE OF GAMMA IRRADIATION ON THE PROVITAMIN A (β-CAROTENE) IN SOLUTION. Snauwaert, F.; Tobback, P. P.; Anthonissen, A.; Maes, E. (Univ. Louvain, Hervelee, Belg.). pp 29-46 of Radiation Preservation of Food. Vienna; International Atomic Energy Agency (1973).

From international symposium on radiation preservation of food; Bombay, India (13 Nov 1972). See STI/PUB-317; CONF-721101-.

The degradation under γ irradiation of β-carotene in solution was studied as a function of three parameters: dose, concentration, and nature of the solvent. The degradation mechanism was found to be the result of both the direct and the indirect action of γ rays on the β-carotene molecule. The degradation products were separated by TLC chromatography. A spectrophotometric study showed that cis-trans isomerization, shortenings in the conjugated system, and formation of α-isomers were the most important changes during radiation. At doses higher than 200 krad β-carotene tends to degrade completely. (auth)

24679 DEOXYNUCLEOTIDES: MODELS FOR STUDYING MECHANISMS OF STRAND BREAKAGE IN DNA. 2. Thymidine 3′5′-Diphosphate. Ward, J. F.; Kuo, I. (Univ. of California, Los Angeles). Int. J. Radiat. Biol.; 23: No. 6, 543-557(Jun 1973).

Reactions that cause release of inorganic phosphate from thymidine 3′5′-diphosphate are equivalent to strand-break-producing reactions in DNA. When the former was γ-irradiated in dilute aqueous solution, reactions of the OH· radical induced the liberation of inorganic phosphate. Three types of phosphate release are distinguished: immediately after irradiation, G = 0.17(O_2), G = 0.21(N_2); on standing in neutral solution, G = 0.46(O_2), G = 0.12(N_2); and on treatment with alkali G = 1.8(O_2), G = 0.7(N_2). The sites of OH· radical attack responsible for these three processes are identified. Chromatographic separations indicated that in all cases both sugar phosphate bonds of the parent molecule were broken and no monophosphate products formed. The yields of formation of strand breaks produced by irradiation of DNA in vivo and the mechanisms by which they are repaired are discussed in terms of the three processes by which sugar phosphate bond breakage occurs in thymidine 3′5′-diphosphate. (auth)

24680 DISTRIBUTION OF REPAIR REPLICATION IN THE HeLa CELL GENOME. Meltz, M. L.; Painter, R. B. (Univ. of California, San Francisco). Int. J. Radiat. Biol.; 23: No. 6, 637-640(Jun 1973).

Using HeLa cell DNA, hybridization experiments were carried out with DNA labeled with ^{14}C by repair replication, bulk DNA, and DNA labeled with ^{3}H by semiconservative replication. The results indicated that after an ultraviolet irradiation dose of 500 erg, excision repair occurs randomly throughout the genome, at least in terms of DNA as subdivided by the CoT (concentration x time) technique. (UK)

24681 INACTIVATION OF RIBONUCLEASE A IN AQUEOUS SOLUTIONS BY IONIZING RADIATION. Rokushika, S. (Kyoto Univ.); Murakami, F.; Hatano, H.; Senda, T. J. Radiat. Res.; 13: No. 4, 221-229(Dec 1972).

Ribonuclease A was gamma irradiated in a dilute aqueous solution. The G° value of inactivation of the enzyme was 0.45. When the enzyme lost its enzymatic activity significantly, some physicochemical or chemical properties were found to be altered, while others were not. Unaltered properties were type of amino acid terminals, optimum pH and pH-enzyme activity curves. Properties affected by irradiation were a destruction of some amino acid residues, an alteration of electrophoretic mobility, and an increased reactivity to diazo-1-H-tetrazole. The extents of alteration of the latter two properties were dependent upon the radiation dose. These results suggest that the ionizing radiations induce a local conformational change in the enzyme molecule and that this may play an important role in the inactivation of the enzymatic activity of ribonuclease A. (auth)

24682 EFFECT OF NEUTRONS IRRADIATION ON NUCLEOTIDES OF LYMPH NODES. Jozwiak, Z.; Maluszynska, K.; Mieczyslaw, P.; Leyko, W. (Univ. of Lodz, Poland). Stimulation Newslett.; No. 4, 18-25(1972).

The lowest radiation doses causing ATP changes were investigated. The investigations were carried out in calf lumbar lymph nodes taken immediately after the slaughter and irradiated with neutrons from a Pu–Be source with an energy range of 0.5 to 11 MeV. The absorbed dose is mainly due to elastic scattering. The dose was calculated from the first collision. After irradiation, the lymph nodes were homogenized. The content of nucleotides in the extracts was determined by means of chromatography and spectrophotometry. Adenine nucleotides comprised about 50% of all free nucleotides present. The ratio of all adenine nucleotides showed a considerable increase after irradiation with a maximum after doses of 0.1 to 0.2 rads. The observed increase of adenine nucleotides and the sum of all free nucleotides may be explained by the injuries of the DNA. (GE)

Radiation Effects on Cells

Refer also to abstracts 24675, 24785, 24786, and 24811.

24683 (AEC-tr-7444, pp 57-62) SENSITIVITY OF HeLa CELLS TO NEUTRON AND X IRRADIATION AS A FUNCTION OF THE POSITION OF THE CELLS IN THE GENERATION CYCLE. Baldychev, A. S.; Malinovskii, O. V.; Postnikov, L. N.; Sheikina, T. A. (Inst. of Nuclear Physics, Leningrad). Translated from Radiobiologiya; 13: No. 2, 206-210(1973).

A comparative investigation was made of the sensitivity of a synchronous population of HeLa cells to fast neutrons and hard x radiation in the case of influence in the middle of the G_1 phase, at the G_1–S boundary, and in the middle of the S phase of the mitotic cycle. Kinetic curves of survival were obtained as a function of the average age of the irradiated cells during the first two thirds of the generation cycle. It was discovered that the sensitivity of cells to neutron irradiation is practically unchanged during the G_1 phase. In the interval from the beginning to the middle of the S-period, the sensitivity of the cells to neutron and x irradiation gradually decreases. (tr-auth)

24684 (AEC-tr-7444, pp 131-134) INVESTIGATION OF THE POSSIBILITY OF MODIFICATION OF THE RADIATION LESION OF MAMMALIAN CELLS WITH BACTERIAL DNA LIGASE. Gaziev, A. I.; Kublik, L. N.; Mantsygin, Yu. A. (Inst. of Biological Physics, Pushchino, USSR). Translated from Radiobiologiya; 13: No. 2, 265-268(1973).

Bacterial DNA ligase, introduced into a culture of Chinese hamster fibroblast-like cells, growing in a monolayer, does not influence the radiation death of these cells. Control experiments with ^{14}C-labeled ligase have shown that the enzyme does not penetrate into the cell. This may be the cause of the absence of a modifying effect. (tr-auth)

24685 (AEC-tr-7444, pp 155-158) PROTECTIVE ACTION OF MEXAMINE ON THE SURVIVAL OF HeLa CELLS IN X IRRADIATION. Voronina, M. Ya.; Sheikina, T. A. (Inst. of Nuclear Physics, Leningrad). Translated from Radiobiologiya; 13: No. 2, 284-286(1973).

A radioprotective effect of mexamine on the survival of HeLa cells in sulture after x irradiation at a dose of 540 rad, which is significantly lower than the effects of cysteamine at subtoxic concentrations, was detected. The protection increases with increasing concentration of the protector, and the DRF reaches 1.3 at moderately toxic concentrations. (tr-auth)

24686 (AEC-tr-7444, pp 171-174) ROLE OF THIOLS IN THE CHANGES IN THE RADIOSENSITIVITY IN THE CASE OF FRACTIONATION OF THE RADIATION DOSE. Nekrasova, I. V.; Graveskii, E. Ya. (Inst. of Developmental Biology, Moscow). Translated from Radiobiologiya; 13: No. 2, 294-297(1973).

It was shown in experiments in vivo on Ehrlich's ascites carcinoma cells that according to such indices as the sensitivity of the chromosome apparatus and the rate of tumor growth, their radioresistance is reduced immediately after irradiation at a dose of 350 R, then rises after 4 to 6 hrs, and is again reduced after 24 hrs. The total thiol content in the cell also undergoes analogous changes with time. The presence of a direct correlation between the radioresistance of cells and their thiol content indicates that the change in the radiosensitivity to repeated irradiation is a consequence of the change in the thiol level after the first irradiation.

24687 (TID-26402) BIOLOGICAL EFFECTS OF RADIATION AND RELATED BIOCHEMICAL AND PHYSICAL STUDIES. Proposal 1. Radiation Studies; Theoretical Investigation of LET Spectra and Dose Relationship. Progress Report, May 1, 1971-April 30, 1973. Laughlin, J. S. (Sloan Kettering Inst. for Cancer Research, New York). 31 May 1973. Contract AT(11-1)-3521. 13p. Dep. NTIS $3.00.

The analysis and testing of a biophysical model of oxygen diffusion into a monocellular aqueous layer of cultured cells after exposure to an ultra-high intensity pulse of electrons was carried out and completed by comparing the oxygen concentration calculated on the basis of the model with the corresponding experimental data that give the concentration of oxygen, as a function of time after the pulse, diffusing into the layer (which was rendered anoxic by the pulse) from an oxygen-containing gas above. The model and its mathematical interpretation contain five physical parameters that influence the oxygen diffusion in time. The dependence of RBE and OER on the spectrum of LET at various points in a tissue-like medium arising from a variety of cyclotron produced neutron beams incident to the medium was studied since such beams can differ substantially in the spectrum of their incident neutrons and hence in their effects on the survival of deep-seated anoxic tumor-cells, depending on the mode of their production, and to some extent, the presence or absence of collimation. (CH)

24688 (TID-26403) BIOLOGICAL EFFECTS OF RADIATION AND RELATED BIOCHEMICAL AND PHYSICAL STUDIES. Proposal 2. Radiation Studies; Radiation Mechanisms in Mammalian Systems. Progress Report, May 1, 1971-April 30, 1973. Laughlin, J. S. (Sloan-Kettering Inst. for Cancer Research, New York). 31 May 1973. Contract AT(11-1)-3521. 9p. Dep. NTIS $3.00.

The effects of hypoxia on the survival of cultured HeLa cells were studied following exposure to fast neutrons or ^{252}Cf neutron sources and the results were compared with results using x- and γ beams and ^{226}Ra γ. The experimental system employed to induce hypoxia is based on the physiological depletion of oxygen by dense cell cultures, since this system may mimic certain in vivo tumors in important respects. The effect of cell population density and proliferative state on the radiation sensitivity of different cell types was also investigated using cultured cells. (CH)

24689 (UCLA-12-919, pp 26-27) DEVELOPMENTAL MICROANATOMY. 1973.

In annual progress report for the period ending June 30, 1973.

Progress is reported on the following studies: effects of cortisone and cupuzone on mitochondria of liver cells in culture; surface changes in cultured liver cells in response to dexamethasone; and localization in the nucleus of unscheduled DNA synthesis in response to uv irradiation and carcinogens. The question of whether breaks in heterochromatin in response to x rays or uv were less easily repaired than those in euchromatin was also investigated. (HLW)

24690 X IRRADIATION OF MITOTIC CHINESE HAMSTER CELLS. 1. Damage Expression and Recovery in Surviving Daughter Cells. Nagle, W. A.; Humphrey, R. M. (Univ. of Texas, Dallas). Int. J. Radiat. Biol.; 23: No. 6, 611-625(Jun 1973).

Chinese hamster ovary (CHO) cells synchronized in mitosis were more sensitive to x-ray-induced cell killing than cells in the G_1, early S, or late S phases of the cell-cycle. In addition, radiation damage registered in mitotic cells was expressed by surviving daughter cells during the G_1 and S phase as a reduced capacity to accumulate additional sublethal radiation damage. The magnitude of the reduction in the survival curve shoulder was dependent on the radiation dose administered to the cells in mitosis. During the interval from late S of the first generation after mitotic irradiation to G_1 of the second generation surviving cells recovered the full capacity to accumulate sublethal damage. It is suggested that mitotic cells sustain at least two types of radiation damage: (1) lethal, irreparable damage, and (2) sublethal damage, i.e., fully reparable, but which can contribute to lethality if additional radiation is delivered before complete recovery. (auth)

24691 RECONSTITUTION OF T CELL-DEPLETED SPLEEN CELL POPULATIONS BY FACTORS DERIVED FROM T CELLS. III. Mechanism of Action of T Cell-Derived Factors. Gorczynski, R. M.; Miller, R. G.; Phillips, R. A. (Univ. of Toronto). J. Immunol.; 111: No. 3, 900-913(Sep 1973).

Initiation of an in vitro response to sheep erythrocytes (SRBC) requires the production of a nonspecific soluble mediator, which is present in the culture supernatants of antigen-stimulated thymus-derived (T) cells. This factor was shown to act early in the immune response and probably directly affects bone marrow derived (b) cells. However, the stimulation of the PFC response caused by the factor depends upon the presence of some intact T cells. These T cells can still function after 1300 rads of ionizing radiation. The factor does not simply cause proliferation of small numbers of surviving T cells, and is exhausted from the medium when cultures of B cells with the active supernatant are stimulated with antigen. Further evidence for two functions for T cells during the antibody response in culture has been obtained by studying the ability of cultures of B and A cells to respond when the two T cell functions are provided sequentially. For example, if B cells are preincubated in vitro for 24 hr with an active supernatant, they can give subsequent PFC responses either in vivo or in vitro when mixed with irradiated normal (unprimed) T cells. Investigation of the need for intact T cells has shown that this requirement, unlike the nonspecific factor, represents an antigen-specific function for T cells. This specificity has been demonstrated with irradiated T cells from mice tolerant to SRBC. In the presence of the active supernatant and a suitable B cell source these irradiated T cells can reconstitute the response to horse erythrocytes but not SRBC. (auth)

24692 INABILITY OF LEUKOCYTES TO STIMULATE MIXED LEUKOCYTE REACTIONS. Twomey, J. J.; Douglass, C. C.; Morris, S. M. (Veterans Administration Hospital, Houston, TX). J. Nat. Cancer Inst.; 51: No. 2, 345-351(Aug 1973).

In vitro studies were performed on 12 patients with Hodgkin's disease. Irradiated leukocytes (WBC_x) from 7 patients did not stimulate ^3H-thymidine incorporation in lymphocytes from healthy allogeneic donors. This nonstimulation could not be ascribed to compatibility and was not due to an inhibitor in the patients' plasma, a macrophage abnormality, or poor survival of patients' WBC in vitro. In most cases, the ratio of granulocytes to lymphocytes made it unlikely that poor stimulation by patients' WBC_x was due to inhibition by granulocytes, unless granulocytes from such patients have an unusually potent inhibiting capacity. Defective WBC_x stimulation was associated mainly with reduced responsiveness of patients' lymphocytes to allogeneic control WBC_x and/or phytohemagglutinin. Poor WBC_x stimulation in the mixed-leukocyte reaction was usually associated with rapidly progressive, therapeutically resistant Hodgkin's disease. This test may prove useful for assessing clinical prognosis. (auth)

24693 INDICATORS TO MEASURE EFFECTS OF IRRADIATION ON L STRAIN CELLS IN TISSUE CULTURE. Nakatani, T. (Okayama Univ., Japan). Okayama Igakkai Zasshi; 83: No. 9-10, 435-448(Oct 1971). (In Japanese).

The use of cell volume, intracellular DNA, and cell counts are

described as indicators of the effects of irradiation on cells in tissue culture. The effects of AET (S2-amino-ethylisothiuronium bromide) as chemical protection against radiation hazards as measured by these three indicators was demonstrated. Combined use of the three indicators demonstrated that the effect of radiation on L-strain cells in tissue culture resulted from extension of the cell's mitotic phase and inhibition of cell division. A positive correlation in the indicators was found with high-dose irradiation (800 R) of cells in tissue culture, but there was no correlation noted at lower test doses (200 R and 400 R). This finding demonstrated that it is necessary to study irradiation effects using these indicators in combination, especially at low-dose exposures. The study demonstrated that AET inhibited growth of irradiated L-strain cells and furthermore promoted cell division in tissue culture, thus showing the capacity for AET to protect tissue cells against irradiation. Use of cell growth indicators such as cell volume, intracellular DNA, and cell counts, in combination, seems superior to previous methods of cell studies related to irradiation effects. (auth)

24694 EFFECT OF CONTINUED RADIOPROTECTION ON SUCCESSIVE CYCLES IN PARAMECIUM AURELIA. Croute, F.; Blanquet, Y.; Tixador, R.; Soleilhavoup, J. P. (Univ., Toulouse). Compt. Rend. Soc. Biol.; 166: No. 8, 1170-1173(1972). (In French).

When Paramecium aurelia cultures are shielded from natural radiations, a slowing down in the cellular growth rate is observed, this phenomenon manifesting itself in a prolongation of the cellular cycle. The possible variations in this growth rate during three successive cellular cycles were studied, the cultures being used after a variable number of days following the autogamy. The results obtained confirm the consistency of the extension in the cell cycle under radioprotection. This extension is, however, smaller than that observed previously. The radiosensitivity was found to depend on the autogamy. (auth)

24695 EFFECTS OF IONIZING RADIATION ON SULPHYDRYL AND DISULPHIDE COMPONENTS OF CULTURED MAMMALIAN CELLS. Archer, J. F.; Wills, E. D. (Saint Bartholomew's Hospital, London). Int. J. Radiat. Biol.; 23: No. 6, 571-581(Jun 1973).

Studies were conducted on the effect of γ irradiation with doses of 500 to 2000 rads on the membrane -SH groups of whole HeLa cells, LS cells, and ELD ascites cells, and of protein and non-protein -SH groups of components released from sonicated cells. Membrane -SH groups of HeLa and ELD cells were partially destroyed by irradiation with 1000 rads, but 50 to 60% of the membrane -SH groups of HeLa and ELD cells were unaffected by a dose of 2000 rads. The -SH groups of whole LS cells were even more resistant. Ethylmaleimide (1-100 μM) also reduced the -SH groups of whole ELD ascites cells to nearly 60% of that of untreated cells. The membrane -SH groups of HeLa and ascites cells therefore appear to be of two types, one type that is readily destroyed by irradiation and by N-ethylmaleimide (NEM) and another that is much more resistant to irradiation and to NEM. Total cell -SH components of cells sonicated after irradiation increased, a dose of 2000 rads causing the formation of 20% more -SH groups in HeLa or ELD cells. A redistribution of -SH components also occurred so that the protein -SH groups decreased and the non-protein -SH groups increased. Liberation of short chain peptides containing -SH groups is believed to be mainly responsible for this effect. (auth)

24696 REPAIR REPLICATION AND UNSCHEDULED DNA SYNTHESIS IN MAMMALIAN CELL LINES SHOWING DIFFERENTIAL SENSITIVITY TO ALKYLATING AGENTS. Fox, M.; Fox, B. W. (Christie Hospital and Holt Radium Inst., Manchester, Eng.). Mutat. Res.; 19: No. 1, 119-128(Jul 1973).

Repair replication was measured by CsCl density gradient centrifugation in cell lines showing differential sensitivity to mono- and bifunctional alkylating agents. A correlation between cellular sensitivity as measured by the D_0 value and amount of repair replication was demonstrated after exposure of Yoshida cells to nitrogen mustard (HN_2) and methylene dimethanesulphonate (MDMS). No differences in the amount of repair replication after methyl methanesulphonate (MMS) were observed in two L5178Y cell lines which differed in sensitivity by virtue of the shoulder size only. The Yoshida cell lines showed no difference in sensitivity to MMS and no difference in amount of repair replication. Incorporation of tritiated thymidine ([^{3}H]TdR) after drug treatment was also measured by autoradiography. The qualitative differences observed between the two cell lines were similar to those obtained in density gradient experiments. The temporal pattern of [^{3}H]TdR uptake indicated that the reduced repair replication observed in the sensitive line after HN_2 and MDMS is not due to slower synthesis. The kinetics of [^{3}H]TdR incorporation differed for all three mutagens suggesting that different enzymes may be involved in each case. (auth)

Radiation Effects on Microorganisms

Refer also to abstracts 24639, 24640, 24642, 24646, 24647, 24649-24654, 24677, 24678, 24743, 24744, 24746, 24748-24750, and 24785.

24697 (AEC-tr-7444, pp 139-141) PHOTOREACTIVATING EFFECTIVENESS OF VARIOUS WAVELENGTHS OF VISIBLE LIGHT TO LETHAL DAMAGES INDUCED BY UV IRRADIATION OF YEAST CELLS. Buturlakin, M. S.; Ivanov, B. V. (Voronezh State Univ., USSR). Translated from Radiobiologiya; 13: No. 2, 271-273(1973).

An investigation was made of the ability for photoreactivation of lethal damages caused by the influence of rays on yeast cells Saccharomyces cerevisiae race XI, with the aid of visible light with wavelengths 366, 405, 436, 546, and 576 mμ. It was shown that the maximum photoreactivating effect is exerted by light with wavelengths 405 and 436 mμ. The photoreactivating effect of radiation with the wavelength 366 mμ at first increases with increasing dose, but after a maximum is reached, it drops. (tr-auth)

24698 (AECL-4587) BIOLOGY AND HEALTH PHYSICS DIVISION PROGRESS REPORT, JANUARY 1 TO MARCH 31, 1973. (Atomic Energy of Canada, Ltd., Chalk River (Ontario). Chalk River Nuclear Labs). Jun 1973. 61p. (PR-B-97). Dep. NTIS (U. S. Sales Only) $5.25. AECL $1.50.

Research in biology included the following studies: repair of radiation damage in radiosensitive mutants of yeast cells; UV-induced mutations in yeast; effects of UV and gamma on phage; radiation genetics of Dahlbominus; radiation studies on biting flies; effects of gamma radiation on enzymes of Micrococcus radiodurans; and induction of leukemia and tumors in rats by x radiation. Population research included studies of the risks of induced cancer in irradiated mammals as related to possible human risks and the development of methods for using routine health records in computerized studies of diseases that would be likely to be increased as a result of irradiation. Environmental studies included the following: monitoring of streams and lakes in the vicinity of CRNL; content of ^{137}Cs in plants of Perch Lake; effects of chlorinated hydrocarbons on the mineral balance in fish; effects of thermal effluents from the Gentilly Nuclear Power Station on molluscs; analysis of dissolved matter in the Ottawa River by neutron activation analysis; and estimation of evaporation rate from lakes using natural isotopes. Health Physics studies included the following: modification of neutron spectra by concrete shielding; preparation and properties of Au-Np radiators for fast neutron damage track personal dosimeters; sensitivity of ^{237}Np and ^{232}Th damage track dosimeters to thermal neutrons and gamma rays; thermoluminescence dosimetry; and tritium monitoring. (HLW)

24699 (STI/PUB-317) RADIATION PRESERVATION OF FOOD. Proceedings Series. Proceedings of a Symposium, Bombay, 13-17 November 1972. (International Atomic Energy Agency, Vienna (Austria)). 1973. 783p. (In Several Languages). (CONF-721101-). IAEA $30.00.

Separate abstracts were prepared for 49 papers. Abstracts of two papers appeared in NSA previously as numbers 27: 450 and 27: 7627. (CH)

For abstracts of individual papers see: 24645-24665, 24678, 24702-24721, and 24743-24749.

24700 RADIATION SENSITIVITY AND REPAIR CAPACITY DEPENDENT ON CELL CONCENTRATION. Pohlit, W. (Gesellschaft fuer Strahlen- und Umweltforschung, Munich). Biophysik; 10: No. 1, 33-37(1973).

The influence of cell concentration on the radiosensitivity of diploid yeast cells was tested. At high cell concentrations the oxygen consumption by maintenance energy metabolism of the cells leads to anoxia under certain irradiation conditions. In this way the radiosensitivity is reduced. The same effect may influence the liquid holding repair, which is dependent on the energy flux in the cell. Inhibition of respiration in the cell due to anoxia again leads to an inhibition of liquid holding repair in the cell. (auth)

24701 CROSS SENSITIVITY TO MONO- AND BIFUNCTIONAL ALKYLATING AGENTS OF THREE RADIATION-SENSITIVE SACCHAROMYCES MUTANTS. Laskowski, W.; Lehmann-Brauns, E. (Freie Univ., Berlin). Biophysik; 10: No. 1, 51-59(1973).

The inactivation of three radiosensitive haploid Saccharomyces mutants, as well as that of corresponding homozygous diploid mutants, following treatment with the bifunctional alkylating agent diepoxybutane (DEB) or the monofunctional alkylating agents methylmethane-sulfonate (MMS) or methylnitrosoguanidine (MNG) was investigated. Sensitivity to DEB was correlated with sensitivity to uv light. The response to MMS or MNG treatment was more

complex. The most uv-sensitive haploid and diploid mutants were as resistant as wild type after MMS or MNG treatment. Those mutants with an intermediate uv sensitivity were also sensitive after MMS treatment, independent of their state of ploidy. After exposure to MNG, however, a characteristic difference appeared between the sensitivity of the two intermediate sensitive haploids and the corresponding diploids. A model is discussed, interpreting the results obtained as an indication of the existence of at least three different repair mechanisms in Saccharomyces. (auth)

24702 CHEMICAL CHANGES INDUCED BY RADIATION IN IRAQI DATES. Auda, H.; Mirjan, J.; Al-Wandawi, H.; Al-Charchafchi, F. (Atomic Energy Commission, Baghdad). pp 21-28 of Radiation Preservation of Food. Vienna; International Atomic Energy Agency (1973).

From international symposium on radiation preservation of food; Bombay, India (13 Nov 1972). See STI/PUB-317; CONF-721101-.

To assess the biological safety of irradiated dates, studies on the biochemical changes were undertaken to provide relevant data on the changes occurring in the constituents of dates exposed to γ radiation. The results indicate that the most sensitive amino acids appear to be proline, glutamic acid, aspartic acid, serine, histidine, lysine, and tyrosine, while methionine, isoleucine and leucine show a slight increase in both varieties studied. Other amino acids varied in concentration upon irradiation, while total free amino acid nitrogen showed no changes due to irradiation. The carotenoids of dates were reduced by the effect of radiation, the extent of this reduction depending on the physical status of carotenoids during irradiation. For the same irradiation doses, carotenoids in solution were highly susceptible to radiation damage and gradually destroyed with the increase in radiation dose. In the fruits carotenoid destruction was less than in solution. (auth)

24703 PRESERVATION OF TOMATOES BY GAMMA IRRADIATION. Cabrera, M. L.; Loyola, V. V.; Carrasco, A. H. (Univ. Nacional Autonoma de Mexico, Mexico City). pp 47-58 of Radiation Preservation of Food. Vienna; International Atomic Energy Agency (1973). (In Spanish).

From international symposium on radiation preservation of food; Bombay, India (13 Nov 1972). See STI/PUB-317; CONF-721101-.

The chemical and physical changes which occur during post-irradiation storage of Bola tomatoes were evaluated. Four series of 100 samples at the same stage of maturity and of uniform size were divided into five groups each containing 20 samples. Four of these groups were irradiated by means of a 3600 Ci ^{60}Co γ source (doses of 350, 400, 450, and 500 krad and dose rate of 95 R/s), the fifth group being used as a control. The tomatoes were then stored for five weeks in isolated chambers under controlled conditions (18 ± 1°C; 55 ± 5% relative humidity). The following parameters were studied: ascorbic acid concentration; beta carotene concentration; total titratable acidity; concentrations of direct and total reducing sugars; pH; loss of weight; decomposition rate; maturity (judged by color); and induced radioactivity. A statistical model (sample F) of the first seven parameters was used for evaluating the results. It was concluded that the changes in the concentrations of direct reducing sugars and beta carotene, in maturity, and in pH are significant; the changes in the concentrations of total reducing sugars and ascorbic acid and in total titratable acidity are not significant; there was no evidence of induced activity; and there was a reduction in the damage caused by microbial infestation. Results indicate that irradiation favors preservation and that, although there are changes in certain parameters, they are not as pronounced as the effect of the storage time, during which the tomatoes ripen, changing from a slightly green color to the red color characteristic of full maturity. The optimum minimum dose was considered to be 400 krad, that being the dose after which the tomatoes appeared to be in the best physical condition during the observation period of 30 days. (auth)

24704 FATTY ACIDS IN AN IRRADIATED CHICKEN PRODUCT. Rao, M. R. R.; Novak, A. F. (Louisiana State Univ., Baton Rouge). pp 73-85 of Radiation Preservation of Food. Vienna; International Atomic Energy Agency (1973).

From international symposium on radiation preservation of food; Bombay, India (13 Nov 1972). See STI/PUB-317; CONF-721101-.

Lipid studies were conducted on samples of canned non-irradiated and γ-irradiated chicken-based pet food products. The fatty acids of these samples were isolated and identified using gas-liquid chromatography. Classes of lipids in the extracts of non-irradiated and irradiated samples were separated and tentatively characterized by thin-layer chromatography. Total extractable lipid was determined gravimetrically. Phospholipids, sterols, free fatty acids, triglycerides, and sterol esters were demonstrated on thin-layer plates in the samples of both non-irradiated and irradiated chicken products. The triglyceride class was observed to be the most abundant fraction of the total lipids in both types of samples. Fatty acids tentatively identified by gas-liquid chromatography in both the non-irradiated and the irradiated samples were caprylic acid (C_8), capric acid (C_{10}), undecylenic acid (C_{11-}), myristic acid (C_{14}), tetradecenoic acid (C_{14-}), palmitic acid (C_{16}), palitoleic acid (C_{16-}), stearic acid (C_{18}), oleic acid (C_{18-}), linoleic acid ($C_{18=}$), and arachidic acid (C_{20}). The fatty acids that constituted 79.97% of the total fatty acids in the non-irradiated samples were identified as palmitic acid, oleic acid and linoleic acid. There were no differences detected between relative fatty acid composition of the total lipid extract of non-irradiated and irradiated samples. In regard to the major fatty acids identified on gas liquid chromatograms, the composition of the total extract and the lipid fractions in both the non-irradiated and irradiated samples were similar. The relative fatty acid composition of the triglyceride fraction was the closest to the total extract. There were no differences in the relative composition of the fatty acids of the triglyceride fractions of the non-irradiated and irradiated samples. (auth)

24705 PRELIMINARY STUDIES ON THE MICROFLORA OF MAIZE STARCH BEFORE AND AFTER IRRADIATION. Saint-Lebe, L. (CEA, Cadarache, France); Mucchielli, A.; Leroy, P.; Beerens, H. pp 155-164 of Radiation Preservation of Food. Vienna; International Atomic Energy Agency (1973). (In French).

From international symposium on radiation preservation of food; Bombay, India (13 Nov 1972). See STI/PUB-317; CONF-721101-.

Irradiation as a solution to the problem of disinfecting food powders is considered. Studies are being made to make a complete list of the microflora of starch, before and after irradiation, and to do so in respect of extreme degrees of pollution, in order to permit subsequent determination of the doses required to eliminate various species, whether pathogenic or not, as a function of the final utilization of the commodity. Preliminary work has on a number of occasions demonstrated that radiation has a spectacular effect, in the form of the almost total elimination, at doses of 300 krad, of the microorganisms present, particularly moulds, and of sulphite-reducing Clostridium spores. These results appear, prima facie, to be confirmed by similar experiments with potato starch. In addition, an effort is being made to establish the respective roles of radioinduced peroxides and of the ageing of starch in the case of Clostridium perfringens irradiated at low doses. (auth)

24706 GAMMA RADIATION STUDIES OF CLOSTRIDIUM BOTULINUM TYPES A, B, AND E: BIOLOGICAL ASPECTS. Grecz, N.; Lo, H.; Kennedy, E. J.; Durban, E. (Illinois Inst. of Tech., Chicago). pp 177-191 of Radiation Preservation of Food. Vienna; International Atomic Energy Agency (1973).

From international symposium on radiation preservation of food; Bombay, India (13 Nov 1972). See STI/PUB-317; CONF-721101-.

The profiles of gamma radiation survival curves of spores of Clostridium botulinum types A, B and E were analyzed for 14 strains of high, medium, and low radiation resistance. An attempt was made to correlate radiation resistance with electron microscopic and phase contrast cell morphology and with gross colonial appearance in deep agar cultures. The general features of multihit profile of radiation survival were obtained. The initial shoulder was estimated to be 0.14 to 0.31 Mrad in phosphate buffer (PB) and 0.24 to 0.46 Mrad in pork pea broth (PPB), except for strain 51B, which showed no appreciable shoulder in any of the menstrua. The exponential decline portion of the survival curve yielded D_{10}-values varying from 0.10 to 0.24 Mrad in PB and 0.11 to 0.34 Mrad in PPB. Tails up to 10 Mrad (the limit of our tests) were especially pronounced in strains 51B, 33A, 53B (code M) and 9B, in some cases tail counts reached as many as 100 to 300 colonies. Electron microscopically, radiation-resistant strain 33A showed an extensive exosporium enveloping the spore and abundant nuclear material in the core, while radiation-sensitive strain 51B showed an extremely small exosporium and sparing amounts of nuclear material; the overall size of strain 33A was 0.7×1.1 μm, while that of strain 51B was 0.45×0.6 μm. In general, strains with large spores were more resistant to radiation than strain with small spores. However, frequently spore populations appeared non-uniform consisting of mixtures of small and large spores within the same spore crop even though produced from a single colony isolate. The appearance of colonies in deep agar culture was of three general types: strongly lobed solid colonies, associated as a rule with highly radiation-resistant strains; lacy or small-lobed colonies usually but not always associated with radiation-sensitive, particularly type E strains; and small, fluffy, diffuse, cottony colonies usually associated with radiation-sensitive strains. (auth)

24707 COMBINED GAMMA-IRRADIATION AND CHEMICAL TREATMENT IN THE CONTROL OF ASPERGILLUS NIGER VAN TIEGHEM AND FUSARIUM COERULEUM (LIB.) SACC. Roy, M. K.; Mukewar, P. (Indian Agricultural Research Inst., New Delhi). pp 193-200 of Radiation Preservation of Food. Vienna; International Atomic Energy Agency (1973).

From international symposium on radiation preservation of food; Bombay, India (13 Nov 1972). See STI/PUB-317; CONF-721101-.

A dose of 200 krad of gamma radiation has very little fungicidal effect in vitro on the growth of Aspergillus niger, the black mould rot of apples, and Fusarium coeruleum, the cause of dry rot in potatoes. The combination of 1000 ppm Aureofungin or Captan with 200 krad of gamma radiation, however, produces better fungicidal effect on A. niger than either treatment alone, whether in vitro and in host. Captan and irradiation could prevent the progress of black mould rot infection in a high percentage of apples after 20 days of storage at 20°C. The effects of radiation alone or in combination with chemicals on germination and growth of F. coeruleum are discussed. (auth)

24708 SELECTIVE CONTROL OF SPOILAGE ORGANISMS IN SEAFOODS BY GAMMA RADIATION. Lewis, N. F.; Alur, M. D.; Nadkarni, A. R.; Gaonkar, S. G.; Kumta, U. S. (Bhabha Atomic Research Centre, Bombay). pp 201-219 of Radiation Preservation of Food. Vienna; International Atomic Energy Agency (1973).

From international symposium on radiation preservation of food; Bombay, India (13 Nov 1972). See STI/PUB-317; CONF-721101-.

Pronounced differences in the radiation sensitivities of food-borne microorganisms are the basis for development of irradiation processes for fishery and meat products. Microbial shifts in irradiated Bombay duck (Harpodon nehereus), shrimp (Penaeus indicus, Metapenaeus affinus), and pomfret (Stomateus cinereus) are described with special reference to radiation response and spoilage potential of predominant organisms and radiation survivors. Additional observations on: growth and toxin production of irradiated Staphylococcus aureus cells; germination and sporulation characteristics of Bacillus cereus BIS-59 isolated from blanched (100°C, 4 min) and irradiated (0.15 Mrad) shrimp, and the radio-resistant Micrococcus sp. NCTC 10785 isolated from irradiated Bombay duck, are included. (auth)

24709 EFFECT OF GAMMA IRRADIATION ON THE MICROBIAL SPOILAGE PATTERNS OF FISH IN RELATION TO FINAL QUALITY. Bhadra, R.; Chaudhuri, D. R.; Bose, A. N. (Jadavpur Univ., Calcutta). pp 221-230 of Radiation Preservation of Food. Vienna; International Atomic Energy Agency (1973).

From international symposium on radiation preservation of food; Bombay, India (13 Nov 1972). See STI/PUB-317; CONF-721101-.

As a part of investigations on the quality of radiation processed fish during transportation, irradiated (100 krad) Bombay duck (Harpodon nehereus) laminates packed in polyethylene pouches and held at ice temperature were examined for their storage life and bacterial flora. The extension in storage life was determined both by sensory evaluation and in relation to the development of types of bacteria. Bacterial groups producing H_2S and those having high proteolytic activity showed a sharp increase only after 14 to 21 days storage of irradiated samples, while a similar pattern was noted in unirradiated fish kept for 7 days under identical conditions of storage. The flora developed during storage in unirradiated fish showed predominantly Proteus, Aeromonas, Achromobacter and to some extent Pseudomonas, while irradiated samples showed Achromobacter and Micrococcus as the predominating types. The storage life of irradiated fish held under ice and transported from Bombay by train over a distance of about 2000 km was extended by 2 to 3 weeks. (auth)

24710 MICROBIOLOGICAL AND ENTOMOLOGICAL ASPECTS OF THE FOOD IRRADIATION PROGRAM IN AUSTRALIA. Wills, P. A. (Australian Atomic Energy Commission, Sutherland); Clouston, J. G.; Gerraty, N. L. pp 231-259 of Radiation Preservation of Food. Vienna; International Atomic Energy Agency (1973).

From international symposium on radiation preservation of food; Bombay, India (13 Nov 1972). See STI/PUB-317; CONF-721101-.

Over the past ten years γ radiation has been investigated in Australia for its possibilities for disinfesting oranges, bananas, apples, and grain, sprout inhibition of potatoes, quarantine control of beans and extending the shelf-life of fish. These studies are briefly reviewed. Results of research aimed at developing a novel combination sterilization treatment involving moderate hydrostatic pressure, heat, and radiation are reported. Hydrostatic pressure converts radiation and heat resistant Bacillus sp. spores to their more sensitive germinated form prior to inactivation. The resistance of spores to germination by pressure parallels their resistance to heat inactivation. An optimum temperature depending on the pressure exists for each spore species. Kinetic analysis of inactivation from simultaneous application of compression and radiation suggests that the lethal actions of pressure and radiation are independent. Using B. licheniformis spores in milk as a test system, the radiation dose required for a 6-D reduction in population can be reduced from 1.09 Mrad to 0.36 Mrad with appropriate pre-compression. Approximately 10 tons per month of diets for specific-pathogen-free and gnotobiotic laboratory animals are at present being sterilized by radiation at 2.5 and 5.0 Mrad. Details of the radiation process, including microbial inactivation, packaging, vitamin retention, and economics are given. The experiences of three laboratories using γ sterilized diets for rats, mice, and chickens for periods up to two or more years are outlined. (auth)

24711 PRESENT STATUS OF FOOD IRRADIATION RESEARCH IN JAPAN WITH SPECIAL REFERENCE TO MICROBIOLOGICAL AND ENTOMOLOGICAL ASPECTS. Matsuyama, A. (Inst. of Physical and Chemical Research, Saitama, Japan). pp 261-278 of Radiation Preservation of Food. Vienna; International Atomic Energy Agency (1973).

From international symposium on radiation preservation of food; Bombay, India (13 Nov 1972). See STI/PUB-317; CONF-721101-.

In 1967 the national special nuclear research program on food irradiation was initiated to demonstrate the potentiality of the radiation treatment of seven food items: potatoes, onions, rice, wheat, Vienna sausage, the fish paste product "Kamaboko", and Japanese mandarin oranges. Each food item has been subjected to both feasibility and wholesomeness studies for 3 to 5 years. Investigations of sprout inhibition by γ irradiation of potatoes and onions have been completed. Sprout inhibition of Japanese varieties of potatoes and onions was effected by 7 to 15 krad and 3 krad or more, respectively, during the dormancy period, although increased doses were required in the later period of dormancy. Wholesomeness studies on irradiated potatoes in mice, rats, and monkeys indicated that no adverse effect due to radiation was found at doses up to 15 krad. Based on these results, the legal permission in this country for radiation inhibition of potato sprouting (15 krad max.) was issued on 30 August 1972. Permission for irradiated onions is expected soon. In respect of rice irradiation for disinfestation, no significant difference in organoleptic qualities was found between the unirradiated control and samples irradiated with doses up to 30 krad, while the sterilization doses for cereal insects Sitophilus sp. were about 10 krad. A long-term toxicity test in rats fed diets containing 50% of rice unirradiated and irradiated with doses up to 100 krad has already started, together with that on irradiated wheat. Feasibility studies on the shelf-life extension by irradiation of Vienna sausage and Kamaboko and irradiation of mandarin oranges are also in progress. Other fundamental studies associated with food irradiation are briefly reviewed. Some microbiological and entomological problems, such as the basic mechanism for radiation resistance in vegetative bacteria and its destruction (i.e., radiosensitization) and recovery in insects on fractional irradiation, are discussed from the viewpoint of food irradiation. (auth)

24712 RADIATION EFFECTS ON FOUR SPECIES OF INSECTS IN STORED RICE AND THE USE OF RADIATION DISINFESTATION IN THEIR CONTROL. Hoedaya, M. S.; Hutabarat, D.; Sastradihardja, S. I.; Soetrisno, S. (National Atomic Energy Agency, Jakarta, Indonesia). pp 281-294 of Radiation Preservation of Food. Vienna; International Atomic Energy Agency (1973).

From international symposium on radiation preservation of food; Bombay, India (13 Nov 1972). See STI/PUB-317; CONF-721101-.

In relation to rice preservation by gamma radiation the effects of radiation on four species of insects commonly found in Indonesian stored rice have been studied, the main purpose being the determination of sterilizing and lethal doses. The insects were: rice weevil Sitophilus oryzae, flour moth Ephestia species, confused flour beetle Tribolium confusum, and saw-toothed grain beetle Oryzaephilus surinamensis. ^{60}Co γ irradiation unit was used as source, the doses varying from 0 to 100, 0 to 21, 0 to 100, and 0 to 30 krad for Sitophilus oryzae, Ephestia sp., Tribolium confusum, and Oryzaephilus surinamensis respectively. Adult Sitophilus oryzae were sterilized at 7.5 krad and 20 krad killed about 99.9% within 21 days. The sterilizing dose for Ephestia sp. is 45.1 krad for males, 24 krad for females, and 18.2 krad for both combined. After thirty days at the adult stage Tribolium confusum are completely sterilized by 10 krad, while 25 krad produce 100% mortality within 29 days. Doses of 10 krad sterilizes Oryzaephilus surinamensis adults and 20 krad produce total mortality within 15 days. As the damage to stored rice and other

cereals is caused by immature stages of all these insects, which can be prevented by sterilization of the adults, it is considered that the highest sterilizing dose for these insects is sufficient as a disinfestation dose, since recovery was not noted in sterile insects. The study on radiation disinfestation of rice that has been infested simultaneously by all these insects is still in progress. (auth)

24713 PRESERVATION OF MAIZE (ZEA MAIS L.) AND KIDNEY BEANS (PHASEOLUS VULGARIS L.) BY GAMMA IRRADIATION. Revetti, L. M. (Instituto Venezolano de Investigaciones Cientificas, Caracas). pp 339-346 of Radiation Preservation of Food. Vienna; International Atomic Energy Agency (1973). (In Spanish).

From international symposium on radiation preservation of food; Bombay, India (13 Nov 1972). See STI/PUB-317; CONF-721101-.

Samples of maize and kidney beans with a known insect population were exposed to ^{60}Co γ rays. In the maize the insect population consisted of coleoptera and lepidoptera, in the kidney beans only of coleoptera. Radiation doses varying from 10 krad to 50 krad were applied, the dose intervals being 10 krad. After irradiation the samples were kept under controlled temperature and humidity conditions. Sampling was carried out at suitable intervals in order to ascertain the action of the radiation on the grain components. In the maize, a check was made on the acidity of the grain (water-soluble acidity and the acidity of the fat), but no changes suggesting a greater possibility of rancidness of the grain were detected. The iodine concentration in the maize oil did not vary with radiation dose. In the kidney beans, soluble nitrogen was measured to see whether evidence of a direct effect of γ rays on the grain protein fraction could be found, but the analytical methods applied to the irradiated samples revealed no significant changes. The storage life of maize and kidney beans can easily be quadrupled with doses of 20 krad and 30 krad, provided that subsequent contamination is prevented. (auth)

24714 FEASIBILITY OF IRRADIATION OF SPICES WITH SPECIAL REFERENCE TO PAPRIKA. Farkas, J. (Central Food Research Inst., Budapest); Beczner, J.; Incze, K. pp 389-402 of Radiation Preservation of Food. Vienna; International Atomic Energy Agency (1973).

From international symposium on radiation preservation of food; Bombay, India (13 Nov 1972). See STI/PUB-317; CONF-721101-.

The seasonings used in the preparation of industrial meat products and certain canned goods are mostly highly contaminated and contain a large number of heat-resistant cells (bacterial spores). It was found that reduction of 2 to 3 log cycles of the viable cell count of paprika and mixed seasonings is achieved by γ irradiation with 0.3 to 0.4 Mrad. To achieve practically total sterility 1.5 to 2.0 Mrad is required, depending on the initial contamination. The efficiency of the radiation treatment was not significantly affected by the fluctuations in the a_w of the paprika powder that occur in commercial practice. Radiation has no detrimental effect on the quality of the ground paprika. No important change is caused in the chief chemical components (carotenoid content, vitamin C, linolic acid, linolenic acid and capsaicin). The reduction of benzene soluble pigment content and surface color during storage depends on temperature and duration of storage, though it is not essentially affected by irradiation. Irradiation of the seasoning mixture of ground marjoram, ground pepper, and ground paprika specified in brawn manufacture caused no deterioration in the sensory quality of brawn. The viable cell count of the brawn loaves manufactured with irradiated seasonings was substantially lower than those prepared with untreated seasonings. It was found that the use of irradiated seasonings reduced the industrial heat treatment during brawn manufacture by about half, while the microbiological quality of the product was still better than at present. The heat and salt tolerance of the surviving microbial flora in the irradiated seasonings was lower than in untreated seasonings. (auth)

24715 EFFECT OF RADURIZATION ON THE ORGANOLEPTIC, PHYSICO-CHEMICAL, AND STORAGE-LIFE EXTENSION OF DRIED STRIPED MACKEREL STORED AT 30 ± 2°C AND 6 ± 2°C. Pablo, I. S.; Fernandez, R. T.; Coronel, V. Q. (Philippine Women's Univ., Manila). pp 457-469 of Radiation Preservation of Food. Vienna; International Atomic Energy Agency (1973).

From international symposium on radiation preservation of food; Bombay, India (13 Nov 1972). See STI/PUB-317; CONF-721101-.

The effect of storage temperature (30 ± 2°C and 6 ± 2°C) on the shelf-life extension, organoleptic, and physico-chemical changes of γ irradiated dried striped mackerel (Restrelliger chrysozonus) was examined. An optimum dose of 0.1 Mrad was used in this study A shelf-life extension of about 3 weeks was obtained when the dried irradiated samples were stored at 30 ± 2°C. For irradiated samples stored at 6 ± 2°C it took 136 days to reach a 50% spoilage, while it took only 35 days for the non-irradiated samples. The panel of tasters rated both irradiated and non-irradiated and non-irradiated samples as acceptable. A dose of 0.1 Mrad reduced the microbial level by 80 to 95%. The rate of bacterial growth is higher for samples stored at 30 ± 2°C compared with samples stored at 6 ± 2°C. However, samples stored at both temperatures were still acceptable, even when the bacterial count exceeded 10^7 organisms/g. The amount of volatile acids that accumulated in the tissues of the irradiated dried fish increased during storage at both 30 ± 2°C and 6 ± 2°C. On the other hand, the total volatile base content as well as trimethylamine was fairly stable throughout the storage study at both temperatures. Using the above chemical indices as a measure of microbial and chemical activity, the organoleptic attributes of both irradiated and non-irradiated samples did not seem to have been affected by microbial proliferation even up to 10^7 organisms per gram during storage at 30 ± 2°C and 6 ± 2°C. (auth)

24716 IRRADIATION OF MEATS FOR PUBLIC HEALTH PROTECTION. Maxcy, R. B.; Tiwari, N. P. (Univ. of Nebraska, Lincoln). pp 491-504 of Radiation Preservation of Food. Vienna; International Atomic Energy Agency (1973).

From international symposium on radiation preservation of food; Bombay, India (13 Nov 1972). See STI/PUB-317; CONF-721101-.

Shelf life and public health protection were investigated by studying aseptically excised flesh, meat from a central processing operation, and meat from a large retail store with low sanitary quality. The kinds of microorganisms, the population density, and the destructive effect of radiation on the microflora were determined. Meat excised with aseptic care from freshly slaughtered animals contained less than 100 colony-forming units of microorganisms per gram, but the ground product therefrom only had an organoleptically acceptable life of 7 to 10 days at 2°C. In the central processing operation the average count on ground beef was 2.3×10^5. In the retail store the average total count was 5.5×10^7. The latter product was at the threshold of organoleptic spoilage, but distribution systems commonly involve shelf-life extension to this extent. The microflora surviving irradiation was studied to determine its nature and to study the competitive outgrowth during storage. The extent of reduction of the total flora with public health hazards was related to the radiation dose. With 204 krad a log cycle reduction in the total flora and a shelf-life extension to approximately 2 weeks at 2°C was attained. Much of the residual, relatively insensitive flora of ground beef was attributed to Moraxell-Acinetobacter, which was a common contaminant of all sources of red meat studied. Psychrotrophic bacteria were extremely sensitive to radiation, e.g. Pseudomonas fluorescens gave a D_{10} value of 12 krad in low-fat ground beef. D_{10} values for other bacteria were Escherichia coli, 43; Salmonella typhimurium, 64; Salmonella enteritidis, 70; and Staphylococcus aureus, 58 krad. Bacteria were more sensitive to radiation in a high fat product than in a low fat product. General work on other members of the family Enterobacteriaceae indicated gamma radiation to be effective in reduction of their numbers and the associated public health hazards. The results also indicated that a combination of radurization and storage at 2°C would allow central processing and distribution of fresh ground meat with a major improvement in quality assurance and public health protection. (auth)

24717 PROBLEM OF WHOLESOMENESS OF IRRADIATED FOOD. Hickman, J. R. (International Project in the Field of Food Irradiation, Karlsruhe, Ger.). pp 659-672 of Radiation Preservation of Food. Vienna; International Atomic Energy Agency (1973).

From international symposium on radiation preservation of food; Bombay, India (13 Nov 1972). See STI/PUB-317; CONF-721101-.

Problems encountered in research to assess the nutritional quality and toxicological safety of irradiated foods are reviewed. The influence of radiation on the nutritional value of foods can be readily measured and no problems are anticipated in relation to assessing the significance for the consumer of those changes in nutritional value that may occur. The major technique used in the past to demonstrate the safety for consumption of irradiated food has been the long-term animal feeding study. The practical problems involved in the design and conduct of this type of investigation on a processed whole food are reviewed and the shortcomings of information from such studies as a basis for safety evaluation are discussed. An integrated approach, based upon broad-based data from animal feeding studies, specialized toxicological studies on model diets, and a fundamental consideration of the toxicological significance of radiation-induced changes in foods is described. (auth)

24718 NUTRITIONAL AND WHOLESOMENESS STUDIES WITH IRRADIATED FOODS: INDIA'S PROGRAM. Vakil, U. K.; Aravin-

dakshan, M.; Srinivas, H.; Chauhan, P. S.; Sreenivasan, A. (Bhabha Atomic Research Center, Bombay). pp 673-702 of Radiation Preservation of Food. Vienna; International Atomic Energy Agency (1973).

From international symposium on radiation preservation of food; Bombay, India (13 Nov 1972). See STI/PUB-317; CONF-721101-.

Studies are reported on wholesomeness aspects of irradiated foods with special reference to γ irradiated (20 and 200 krad) wheat and semi-dried (40% moisture) and irradiated (0.25 Mrad) shrimp. These include acute and chronic toxicity tests as well as nutritional and compositional changes. Multigeneration feeding trials with wheat do not show any deleterious effects in rats and mice, as assessed by growth, reproduction, haematology, histology, etc. Proximate constituents or total amino acid profiles are not changed to an extent as to affect nutritional quality. However, there is molecular fragmentation of starch and proteins, thus influencing rheological properties and baking qualities of irradiated wheat. Effects of low-dose irradiation on germination are revealed in impaired seedling growth and decreased synthesis of gibberellins and of alpha-amylase. Long-term feeding experiments with dehydro-irradiated shrimp have established wholesomeness of the product. Compositional changes and nutritional losses due to irradiation are comparable to those caused by conventional processing methods and can be minimized by packing under nitrogen or in vacuum prior to irradiation. In vitro proteolytic digestibility of shrimp is significantly increased in the irradiated sample. (auth)

24719 WHOLESOMENESS TESTING OF RADAPPERTIZED, ENZYME INACTIVATED BEEF. Raica, N. Jr. (Army Medical Research and Nutrition Lab., Denver); Baker, R. W. pp 703-714 of Radiation Preservation of Food. Vienna; International Atomic Energy Agency (1973).

From international symposium on radiation preservation of food; Bombay, India (13 Nov 1972). See STI/PUB-317; CONF-721101-.

The progress of the US Army's radappertization program is reviewed. The approval by the Food and Drug Administration (FDA) of radappertized bacon that was granted in 1963 was, upon review in 1968 of the same data, rescinded because safety was not proven. In making this decision it was also noted that because almost all of the wholesomeness data accumulated since 1954 was obtained for foods radappertized at ambient temperatures with spent fuel rods, these data would not be valid for enzyme inactivated food radappertized at low temperature (-30°C) with ^{60}Co γ or electrons. Because of these decisions by FDA and because of the continuing confidence in radappertization, the US Army has initiated a long-term wholesomeness study with low-temperature, ^{60}Co γ or electron radappertized enzyme-inactivated beef. This study, which has been in progress for about 18 months, has incorporated all of the newer concepts for wholesomeness testing of foods and food preservation processes. (auth)

24720 IN VITRO AND IN VIVO STUDIES ON THE TOXICITY OF IRRADIATED SUCROSE SOLUTIONS. De, A. K.; Aiyar, A. S.; Sreenivasan, A. (Bhabha Atomic Research Centre, Bombay). pp 715-726 of Radiation Preservation of Food. Vienna; International Atomic Energy Agency (1973).

From international symposium on radiation preservation of food; Bombay, India (13 Nov 1972). See STI/PUB-317; CONF-721101-.

Studies with rat liver tissue in vitro have shown that a fraction derived from an irradiated (0.5 Mrad) sucrose solution and reportedly cytotoxic to cell cultures inhibits succinate oxidation and, even more so, coupled phosphorylation by mitochondria. Syntheses of lipids, proteins, and DNA are also inhibited, presumably as a result of primary impairment of ATP formation. These data strongly suggest that interference with ATP synthesis may underlie many of the reported biological responses of living organisms to irradiated media. Similar uncoupling of rat liver mitochondrial oxidative phosphorylation is also shown by hydrogen peroxide and carbonyl compounds such as acetone, formaldehyde, and glyoxal, but only at concentrations much above those in which they are reported to be formed in irradiated sugar solutions. Contrary to the reported observations with some microorganisms, the hydroxy-alkyl peroxides formed by the interaction of the carbonyls with hydrogen peroxide do not appear to be the specific agents responsible for the uncoupling. Short- (8 weeks) and long-term (2 years) feeding studies with irradiated sucrose solution have not revealed any adverse effects on growth, specific organ weights, or on fine structure of cells, in rats. Liver mitochondrial oxidative phosphorylation and the incorporation of labeled precursors into proteins and lipids are also normal. These observations serve to emphasize that in vitro toxicity need not be paralleled by toxicity in whole animals. (auth)

24721 TOXICOLOGICAL EVALUATION OF IRRADIATED MAIZE STARCH: A PROGRESS REPORT. Saint-Lebe, L. (CEN de Cadarache, St.-Paul-lez-Durance, France); Berger, G.; Mucchielli, A.; Coquet, B. pp 727-740 of Radiation Preservation of Food. Vienna; International Atomic Energy Agency (1973). (In French)

From international symposium on radiation preservation of food; Bombay, India (13 Nov 1972). See STI/PUB-317; CONF-721101-.

The study of the disinfecting by irradiation (gamma rays, ^{60}Co) of foodstuffs in powder form has been concerned with the treatment of maize starch. The dose required for this purpose, which is not more than 300 krad, depends on the future utilization of the commodity. An analysis of the problems raised by the toxicological evaluation of irradiated food and the fact that starch, which is a basic component of a large number of manufactured foodstuffs, is also a representative of the amyloids and their derivatives, have resulted in the research being oriented in three different directions: An overall toxicological evaluation by means of animal tests, which remain essential but which are not in themselves sufficient. The semi-long-term experiments carried out with rats fed on raw and cooked starch irradiated at doses of 300 and 600 krad have been extended to a study on the reproductive process. The results obtained after one year have revealed no significant effects. The identification and determination of the substances formed during irradiation. So far, aldehydes, sugars, acids and hydrogen peroxide have been identified and determined in irradiated starch; they have been shown to be present in very small quantities. An irradiation test based on determination of malonic aldehyde has been developed. Studies on sugars are being undertaken to establish a scheme for the breakdown of starch under irradiation. Study of the possible toxicity of radiolysis products through the intermediary of work on microorganisms. The lethal effect that has been demonstrated in the case of cultures of Escherichia coli in media rich in irradiated starch extract is largely due to the hydroxy alkyl peroxides formed by oxidation during irradiation. (auth)

24722 BIOLOGICAL PROPERTIES OF MOLDS IN URANIUM MINES. Adamek, M.; Roth, K.; Grozdanovic, J.; Horackova, J. (Inst. of National Health in Uranium Industry, Pribram, Czech.). Sb. Ved. Odbornych Pr., Zavodni Ustav Narodniho Zadravi Uranoveho Prum., Pribram; 5: 25-27(1970). (In Czech).

Symbiotic and parabiotic relationships were studied between molds found in uranium mines and employees of the mines. Toxic properties of conidia with absorbed radioactivity were determined experimentally. A possible dissemination was confirmed of molds conidia in the organism of mice, mainly in the parenchyma of the liver, spleen, and lungs. A pathogenic effect was observed of the application of conidium suspension to an intact host. On the other hand, a protective effect was observed, manifested by an increased survival of some mice exposed to a lethal dose. (NSA of Czech.)

24723 EVIDENCE FOR DIFFERING MODES OF INTERACTION OF ACRIFLAVINE WITH ULTRAVIOLET-INDUCED LESIONS IN AN Hcr$^+$ BACTERIAL STRAIN. Forage, A. J.; Alper, T. (Hammersmith Hospital, London). Mol. Gen. Genet.; 122: No. 1, 89-100(1973).

In buffer suspensions of uv-irradiated Escherichia coli B/r WP2 Hcr$^+$ (auxotrophic for tryptophan), acriflavine binds to DNA, but this treatment has little effect on killing and results in the appearance of fewer prototrophs on tryptophan-supplemented minimal agar. If plates contain a broth supplement, however, the buffer-acriflavine treatment greatly increases the yield of uv-induced prototrophs; but this increase does not depend on complete binding of acriflavine to the DNA as a whole, since it is observed with contact times too short for this to occur (as short as 20 seconds). The incorporation of acriflavine in both kinds of plating medium increases the yields of prototrophs. The maximum yield is observed when irradiated bacteria are exposed to acriflavine in buffer before they are plated on medium containing both acriflavine and a broth supplement. Thus post-irradiation effects of acriflavine cannot be accounted for in terms of a single mechanism of action. The results support the suggestion that phenomena classed together as mutation frequency decline may not represent a single specific repair system. (auth)

24724 PROPERTIES OF STRAINS OF ESCHERICHIA COLI K12 CARRYING MUTANT LEX AND REC ALLELES. Brooks Low, K. (Yale Univ., New Haven); Moody, E. E. M.; Mount, D. W. Mol. Gen. Genet.; 121: No. 3, 197-205(1973).

Strains of Escherichia coli K12 were constructed that carry the lex-3 mutation in combination with recA56, recB21, or recC22. The lex$^-$recA$^-$ strain is equally as sensitive to ultraviolet light (uv) and ionizing radiation and as recombination-deficient as the corresponding lex$^+$recA$^-$ strain, whereas the lex$^-$recB$^-$ and lex$^-$recC$^-$ strains are somewhat more sensitive to uv and ionizing radiation

than the corresponding lex⁻rec⁺ strain and have approximately the same recombination deficiencies as the respective lex⁺recB⁻ and lex⁺recC⁻ strains. When cultures of the lex⁻recB⁻ and lex⁻recC⁻ strains are uv-irradiated, they degrade their DNA at the low rate characteristic of lex⁺recB⁻ and lex⁺recC⁻ single mutants, in contrast to the high rate of degradation seen with lex⁻rec⁺ single mutants. These results imply that the lex⁺ and recA⁺ products act in the same pathway of DNA repair and that both are needed to limit the DNA breakdown due to the recB⁺/C⁺ nuclease. (auth)

24725 STUDIES ON PRODUCTION OF NUCLEIC ACID DERIVATIVES BY MICROORGANISMS. I. Isolation of Adenineless Mutants from Brevibacterium ammoniagenes. Bae, M.; Lee, K. J. Korean J. Microbiol.; 10: No. 2, 73-78(1972).

As the first step in the production of nucleic acid derivatives by microorganisms, adenineless mutants were derived from Brevibacterium ammoniagenes ATCC 6872. A culture of Br. ammoniagenes was exposed to uv rays for 120 sec and treated with diethylsulfate in phosphate buffer for 2 hrs to reach the designed death rate. The yield of mutants induced was 0.28% by the uv irradiation and 0.66% by the diethylsulfate treatment. By the treatment of penicillin G in a hypertonic minimal medium, the yield of mutants was increased from 0.28% to 0.54% and from 0.66% to 1.5%, respectively. Thus, it was demonstrated that diethylsulfate treatment was much more efficient than uv irradiation to induce adenineless mutants of the bacteria, and total strains of 120 adenineless mutants were obtained. (Korean Sci. Abstr.)

24726 EXPERIMENTS IN TREATING VEAL WITH IONIZING RAYS AND HEAT. Gruenewald, T.; Muenzer, R. (Bundesforschungsanstalt fuer Lebensmittelfrischhaltung, Karlsruhe, Ger.). Fleischwirtschaft; 53: No. 3, 391-392(1973). (In German).

To investigate the possibility of lengthening shelf-life by a combination of irradiation and heat treatment, balls of minced meat, sealed in plastic bags, were irradiated with electrons at doses of up to 600 krad and either grilled or heated for 5 min in boiling water. Irradiation and heating were carried out as a single treatment and also a combined treatment. The samples were examined microbiologically and organoleptically over a period of 3 weeks. The experiments showed that shelf-life can be extended and sensory properties improved by using the combined method. (auth)

24727 MUTAGENICITY TESTING OF IRRADIATED FOOD STUFF USING THE DOMINANT LETHAL TEST. Renner, H. W. (Bundesforschungsanstalt fuer Lebensmittelfrischhaltung, Karlsruhe, Ger.); Gruenewald, T.; Ehrenberg-Kieckebusch, W. Humangenetik; 18: No. 2, 155-164(1973). (In German).

The possible mutagenic effect of an irradiated diet was studied using 716 rats (5 generations) and 750 mice (1 generation). The diet consisted of 35% whole milk powder, irradiated with a dose of 4.5 Mrad, and 65% of standard rat diet. In the experiment with mice, an additional group received the same diet, but all of it was irradiated. In the rat tests, the consumption of the irradiated diet did not cause any differences in fertility, duration of pregnancy, litter size, weaning index, sex ratio, or number of fetal malformations. The fertility of male and female mice was also found to be unaffected. Data from five variables of the dominant lethal test on rats and mice were subjected to statistical evaluation and no embryotoxic or mutagenic effects were found. The high content of free radicals in the irradiated food did not give rise to harmful effects in any of the parameters studied. (auth)

24728 SUPPRESSION OF PHOTOREACTIVATING ENZYME PRODUCTION IN ESCHERICHIA COLI GROWN UNDER ANAEROBIC CONDITIONS. Tyrrell, R. M. (Argonne National Lab., IL). J. Bacteriol.; 115: No. 1, 450-452(Jul 1973).

Studies with two K-12 mutants of Escherichia coli exposed to uv radiation have indicated that the production of photoreactivating enzyme is suppressed under anaerobic growth conditions. Under no condition tested could the estimated number of photoreactivating enzyme molecules per cell be reduced below an average of one. (auth)

24729 ROLE OF NUTRIENT BROTH SUPPLEMENTATION IN UV MUTAGENESIS OF E. COLI. Bockrath, R.; Cheung, M. K. (Indiana Univ., Indianapolis). Mutat. Res.; 19: No. 1, 23-32(Jul 1973).

Postirradiation expression of uv-induced reversion was examined to understand the differential yields of E. coli revertants on agar media unsupplemented, supplemented with a small amount of the required amino acid, or supplemented with nutrient broth. Protein synthesis is determined in irradiated cells incubating on these three media by observing the incorporation of [³H]proline. Nutrient broth supplementation is known to yield a large number of suppressor-containing revertants which does not develop with supplementation of a small amount of the required amino acid. However, the rates of protein synthesis in cells on these two media are found to be similar. Consequently the rate of protein synthesis per se does not seem responsible for enhanced expression of suppressor-containing revertants. An empirical model is proposed to relate nutrient broth enhancement to mutation frequency decline and finalization of GC to AT transitions. (auth)

24730 INFLUENCE OF STREPTOMYCIN ON UV-INDUCED TRP⁺ REVERSIONS IN A STREPTOMYCIN-RESISTANT STRAIN OF E. COLI B/R. Clarke, C. H. (Univ. of East Anglia, Eng.). Mutat. Res.; 19: No. 1, 43-47(Jul 1973).

UV mutagenesis was compared in the E. coli B/r Trp⁻ strain WWP-2 Hcr⁺ and in a mutant (Stm^R 28) resistant to 100 μg streptomycin/ml. In the Stm^R strain it is possible to score uv-induced Trp reversions, and survival, on media supplemented with, or lacking, streptomycin. Such experiments revealed a marked enhancement of mutagenic effect of uv by streptomycin. On analysis it was shown that in the Stm^R strain a fraction of uv-induced Trp⁺ reversions, due to ochre suppressors, achieve full phenotypic expression only in the presence of streptomycin. Thus an inhibitory effect of the Stm^R 28 mutation on the activity of some ochre suppressors is relieved by streptomycin. (auth)

24731 DEPENDENCE OF UV-INDUCED REVERSIONS TO PROTOTROPHY ON THE STREPTOMYCIN RESISTANCE ALLELE IN ESCHERICHIA COLI. Skavronskaya, A. G.; Aleshkin, G. I.; Likchoded, L. Y. (Gamaleya Inst. for Epidemiology and Microbiology, Moscow). Mutat. Res.; 19: No. 1, 49-56(Jul 1973).

UV-induced mutability to prototrophy depended on the alleles of the strA locus. The yield of uv-induced suppressor mutations was decreased ten-fold in a Str^r strain compared with an isogenic Str^s strain. This decrease was due to the inability of the majority of suppressors to be expressed phenotypically in the Str^r strain in the course of selection. The addition of streptomycin to the selective media raised the number of selected suppressor revertants, by making such expression possible. The probable relation of streptomycin resistance and uv-induced suppressors is discussed. (auth)

Radiation Effects on Plants

Refer also to abstracts 24501, 24634, 24702, 24703, 24717, 24785, and 24786.

24732 (AEC-tr-7444, pp 119-124) GERMINATING CAPACITY OF SEEDS, GROWTH, AND SURVIVAL OF PLANTS IRRADIATED WITH FAST NEUTRONS AND GAMMA RAYS. Dishler, V. Ya.; Kavats, G. E.; Eizenberg, V. T. (Inst. of Biology, Riga). Translated from Radiobiologiya; 13: No. 2, 255-259(1973).

In the irradiation of dry barley seeds with fast neutrons, a linear decrease in the germinating capacity of the seeds and survival of the plants was detected with increasing dose, while under the influence of γ rays a sharp injurious effect was observed only at a comparatively high dose (30 kR). The dose curves of the growth of the plants are linear under the influence of neutrons and γ rays, both at the beginning and at the end of vegetation. The RBE of fast neutrons is approximately 30 with respect to germinating capacity of seeds, approximately 60 with respect to height of plants, and approximately 10 with respect to survival. (tr-auth)

24733 (AEC-tr-7444, pp 163-166) EFFECTS OF 50 MeV ELECTRONS ON PISUM SATIVUM SEEDS IN AN ATMOSPHERE OF OXYGEN PRESSURE. Avakyan, Ts. M.; Asaturyan, R. A.; Kochinyan, E. A. (Erevan Physical Inst.). Translated from Radiobiologiya; 13: No. 2, 284-286(1973).

In the irradiation of dormant seeds of Pisum sativum with 50 MeV electrons, the presence of an oxygen effect was demonstrated. An inverse relationship between the amount of endogenous thiols and the intensity of the ultraweak luminescence of the rootlets of the plants was simultaneously detected. (tr-auth)

24734 (AEC-tr-7444, pp 167-170) INFLUENCE OF GAMMA IRRADIATION OF SEEDS ON THE REDUCING FUNCTION OF THE PHOTOSYNTHETIC APPARATUS. Kurganova, L. N. (Gorky State Univ., USSR). Translated from Radiobiologiya; 13: No. 2, 292-294(1973).

An increase in the ability of the chloroplasts to carry out electron transport associated with a reduction of NADP and ferredoxin in plants grown from buckwheat and pea seeds irradiated at a stimulating dose of 0.5 kR leads to a sharp decrease in growth processes and photoreduction of NADP by the chloroplasts of buckwheat and pea seedlings. A direct relationship was demonstrated between the photoformation of NADP · H_2 in plants grown from irradiated seeds and the level of photochemical activity of the chloroplasts. (tr-auth)

24735 (AEC-tr-7444, pp 183-188) ROLE OF THIOLS IN THE DETERMINATION OF THE RADIOSENSITIVITY OF WHEAT SEEDS. Semerdzhyan, S. P.; Ior-Arevyan, I. G.; Oganesyan, D. O. (Armenian Scientific Research Inst. of Agriculture,

Echmiadzin). Translated from Radiobiologiya; 13: No. 2, 303-306(1973).

The influence of various modifying factors (5-mercaptoethylamine, B-6, N-ethylmaleimide, and aging) on the radiosensitivity of wheat seeds of the Artashati 42 and Eritroleukon 12 varieties and the total SH group level in the embryos of these seeds was investigated. It was shown that there is an inverse correlation between the total SH group level in the embryos and the modified radiosensitivity of wheat seeds. (tr-auth)

24736 (AEC-tr-7444, pp 193-197) PECULIARITIES OF THE ACTION OF GIBBERELLIN ON GAMMA-IRRADIATED BARLEY PLANTS. Zabolotskii, N. N.; Voronova, G. D. (Moscow Dept. of the All-Union Inst. of Horticulture). Translated from Radiobiologiya; 13: No. 2, 309-313(1973).

It was shown that the radioprotective action of gibberellin on the growth of the growth cones of barley irradiated in the phase of booting, depends to a substantial degree on the dose of irradiation. The action of gibberellin on the sterility of the heads, the yield of grain, and its germinating capacity depends on the age of the irradiated plants. In certain cases this action is negative. A difference in the response of nonirradiated and irradiated plants to gibberellin was noted. (tr-auth)

24737 (NP-19839) REPORT OF THE BOSE INSTITUTE FOR 1970-71. (Bose Inst., Calcutta (India)). [nd]. 121p. Dep. NTIS (U. S. Sales Only)

Summaries are presented of research in the fields of physics, chemistry, botany, microbiology, and animal physiology. Forty-two publications are listed in an appendix. (HLW)

24738 (UCLA-12-919, pp 39-43) PLANT ECOLOGY. 1973. In annual progress report for the period ending June 30, 1973.

Studies on radioecology and ecophysiology of desert plants at the Nevada Test Site were published in book form and included radiation effects on plants, radionuclide distribution, autoecology of plant species, synecology of perennial species, phenology, aspects of mineral cycling, and water relations. Progress is also reported on the following research projects: revegetation in areas damaged by close-in fallout from nuclear detonations at the Nevada Test Site; partitioning of photosynthetically fixed ^{14}C in perennial plants of the northern Mojave desert; root and stem relationships among ten species of northern Mojave desert plants; vertical root profiles of perennial plant species from the Rock Valley area of the northern Mojave desert; comparative photosynthetic production in Mojave desert shrubs; turnover of ribulose 1,5-diphosphate carboxylase in barley leaves; contribution of salts to the water potential of woody shoots; and transpiration and CO_2 fixation of selected desert shrubs as related to soil-water potential. (HLW)

24739 EFFECTS OF STORAGE CONDITIONS ON SURVIVAL AND FREE RADICAL POPULATIONS IN DRIED IRRADIATED SPORES OF OSMUNDA REGALIS. Dodd, N. J. F.; Ebert, M. (Christie Hospital and Holt Radium Inst., Manchester, Eng.). Biophysik; 10: No. 1, 79-88(1973).

Spores of the fern Osmunda regalis were irradiated and stored for 8 weeks in N_2, NO, H_2S, and O_2. They were examined at increasing times after irradiation using both ESR and survival techniques. A synergistic, damaging effect of O_2 and radiation was observed on storage. In contrast to the positive correlation of free radical changes with post-irradiation oxygen damage in short term experiments, damage observed on prolonged storage in O_2 cannot be correlated with the observed radical changes. The mechanisms by which O_2 acts shortly after irradiation and on storage are different. The slow decay of radiation-produced radicals in spores irradiated and stored in N_2 was found to have no influence on the extent of radiobiological damage, which was unchanged with time. However, the ESR results indicate a slow thermal annealment of radicals that were thought to be thermally stable and that were correlated with precursors of post-irradiation oxygen damage. The anoxic component of radiobiological damage in spores irradiated in NO or H_2S appeared to be unaffected by the extensive decay of radiation-produced radicals occurring on storage. (auth)

24740 INDUCED VARIATION AND RESPONSE TO SELECTION FOR LOW NEUROTOXIN CONTENT IN LATHYRUS SATIVUS. Nerkar, Y. S. (Indian Agricultural Research Inst., New Delhi). Indian J. Genet. Plant Breed.; 32: No. 2, 175-180(Jul 1972).

The possibility of producing neurotoxin-free mutants of L. sativus using EMS and γ rays was studied. The results on induced variation, heritability, and response to selection for low neurotoxin content are presented. (ERB)

24741 INTERCHANGE TRISOMICS IN PISUM. Das, K.; Kalloo (Banaras Hindu Univ., India). Indian J. Genet. Plant Breed.; 32: No. 2, 207-210(Jul 1972).

The morphology and cytology of three interchange-trisomics isolated from translocation heterozygotes obtained from gamma-irradiated pea seeds are described. (ERB)

24742 INDUCED MUTATIONS IN ROSES. Kaicker, U. S.; Swarup, V. (Indian Agricultural Research Inst., New Delhi). Indian J. Genet. Plant Breed.; 32: No. 2, 257-265(Jul 1972).

Mutations induced in roses by treatment with chemical mutagens or γ rays are described. Mutations were induced by irradiation or treatment of developing buds. (ERB)

24743 SOME CHEMICAL ASPECTS OF GAMMA-IRRADIATED ONIONS. Bandyopadhyay, C.; Tewari, G. M.; Sreenivasan, A. (Bhabha Atomic Research Centre, Bombay). pp 11-19 of Radiation Preservation of Food. Vienna; International Atomic Energy Agency (1973).

From international symposium on radiation preservation of food; Bombay, India (13 Nov 1972). See STI/PUB-317; CONF-721101-.

Gamma irradiation, in the dose range 6 to 15 krad, can be effectively employed for the prevention of sprouting in stored onions, provided the bulbs are irradiated within a short time after harvesting. Assessment of wholesomeness of irradiated onions through conventional feeding experiments poses certain difficulties since onions, even unirradiated, are not acceptable to laboratory animals except in very small quantities. However, information can be obtained by analysis for changes, if any, in the chemical constituents of onions as a result of irradiation. In the present work freshly harvested red globe onions were irradiated at doses of 6, 10, 20, and 50 krad and stored at ambient temperatures (25 to 30°C) for 3 months along with unirradiated control samples. A comparative study of volatile and some non-volatile constituents of control and irradiated samples was carried out with the help of gas liquid chromatography, thin layer chromatography, and infra-red spectroscopy. The results suggest that there is no effect of γ irradiation up to a dose of 50 krad on freshly harvested red globe onions with respect to the chemical parameters studied. (auth)

24744 INFLUENCE OF GAMMA RAYS ON THE CHLOROPHYLL CONTENT IN PEAS (PISUM SATIVUM). Snauwaert, F.; Tobback, P. P.; Verhees, J.; Maes, E. (Univ. Louvain, Heverlee, Belg.). pp 61-72 of Radiation Preservation of Food. Vienna; International Atomic Energy Agency (1973).

From international symposium on radiation preservation of food; Bombay, India (13 Nov 1972). See STI/PUB-317; CONF-721101-.

The stability of chlorophyll was studied in situ (in pea varieties Onyx, Finette, and Cobri) and in solution. Only chlorophyll a and b are found in freshly harvested peas. On γ irradiation no visible changes in color were found, even with doses up to 2 Mrad. In addition, irradiation had a remarkable effect on the extractability of the chlorophylls. During irradiation the corresponding pheophytins and colorless derivatives of the chlorophylls are found. The sensitivity to photo-oxidation of extracts from irradiated peas was highly enhanced and depended upon the dose used. The destruction rate of the chlorophylls in the skins and the total peas was compared. In solution the chlorophylls were very sensitive to gamma rays. (auth)

24745 REDUCING OLIGOSACCHARIDES IN SOYBEANS BY GAMMA RADIATION CONTROLLED GERMINATION. Hasegawa, Y.; Moy, J. H. (Univ. of Hawaii, Honolulu). pp 89-103 of Radiation Preservation of Food. Vienna; International Atomic Energy Agency (1973).

From international symposium on radiation preservation of food; Bombay, India (13 Nov 1972). See STI/PUB-317; CONF-721101-.

The feasibility of converting soybeans to a more digestible and faster cooking form through controlled germination was investigated. Selective doses of γ radiation between 0 and 1.0 Mrad were applied to 2-hr steeped samples to limit sprouting but to allow the enzyme systems in the beans to remain active for the breakdown of oligosaccharides, which have been reported as gas-producing factor in beans. Rootlet growth was measured after 144 hr of incubation at 30°C. At 500 krad germination was completely suppressed while treatment with 250 krad resulted in only 35 to 40% of the beans having measurable rootlets. Monosaccharides, sucrose, raffinose and stachyose from both the 250-krad treated sample and the control were identified and quantified. Concentrations of raffinose and stachyose in the treated samples were greatly reduced, dependent, however, on prior germination time before irradiation (2, 24, or 48 h) and total incubation time (96 or 144 hr. Among various samples studied, a promising intermediate product was one irradiated at 250 krad after 24 hr of germination. Analysis after 96 hr of incubation showed raffinose and stachyose reduced by 75.6 and 82.4% respectively. Texture of the cooked, air-dried, irradiated sample was softer than the control as measured by a shear press, suggesting a possible reduction in cooking time of about 34%. (auth)

24746 LOWER RADIATION LEVELS FOR BETTER STORAGEABILITY OF POTATOES AND ONIONS USING CERTAIN CHEMICAL TREATMENTS. Roushdy, H. M.; Shukry, K.; Mahmoud, A. A. (Atomic Energy Establishment, Cairo). pp 105-125 of Radiation Preservation of Food. Vienna; International Atomic Energy Agency (1973).

From international symposium on radiation preservation of food; Bombay, India (13 Nov 1972). See STI/PUB-317; CONF-721101-.

Gamma radiation was utilized to maintain better storageability of Egyptian potatoes and onions. To avoid the undesirable chemical and organoleptic changes often caused in food by high radiation levels, the synergistic effect of gamma radiation with the phenolic compound salicylic acid was utilized. The results obtained indicated promising possibilities. Using such combined effects, better storageability was attained using radiation levels sometimes as low as about one half of some approved international levels placed on commercial application for the inhibition of sprouting in potatoes and onions. However, this synergistic effect, its kinetics, and the role it plays in improving the keeping qualities of potatoes and onions seem to be rather obscure and await further investigation. This seems to underlie promising possibilities for future economic applications. (auth)

24747 INHIBITION OF SPROUTING IN STORED YAMS, DIOSCOREA ROTUNDATA POIR, BY GAMMA RADIATION AND CHEMICALS. Adesuyi, S. A. (Nigerian Stored Products Research Inst., Ibadan); Mackenzie, J. A. pp 127-136 of Radiation Preservation of Food. Vienna; International Atomic Energy Agency (1973).

From international symposium on radiation preservation of food; Bombay, India (13 Nov 1972). See STI/PUB-317; CONF-721101-.

Yams, Dioscorea spp., are a principal source of calories in the Nigerian diet. Considerable weight losses of between 15 and 50% occur during storage for periods varying from three to six months. These losses are due mainly to sprouting, other physiological changes, and microbial deterioration. Two methods for preventing sprouting in yams during storage were investigated, γ irradiation and the application of chemicals such as maleic hydrazide, tetrachloro-nitrobenzene, 1-naphthylacetic acid, and methylester of 1-naphthylacetic acid. Radiation was found to be effective treatment for the inhibition of sprouting of yams for a storage period of six months at doses between 7500 and 15,000 rads without inducing adverse changes in acceptability or physiological properties. Doses higher than 15,000 rads were effective in inhibiting sprouting but tended to damage the internal tissues of the yam tubers. The chemical treatments were not effective in inhibiting sprouting or preventing physiological changes resulting in losses during storage with the methods employed in this study. Doses of 100,000 and 200,000 rads had no significant effect on the microbial deterioration of irradiated yams. (auth)

24748 INFLUENCE OF GAMMA RADIATION ON THE PRODUCTION OF AROMA COMPONENTS IN APPLES (VARIETY BOSKOOP) DURING RIPENING AND STORAGE. Tobback, P. P.; Glandian, R. E.; Blockeel, A.; Maes, E.; Herregods, M. (Univ. Louvain, Hervelee, Belg.). pp 137-152 of Radiation Preservation of Food. Vienna; International Atomic Energy Agency (1973).

From international symposium on radiation preservation of food; Bombay, India (13 Nov 1972). See STI/PUB-317; CONF-721101-.

The influence of γ radiation on the production of aroma components in Boskoop apples during growth on the tree and during subsequent storage at 23 and 3°C is studied. The evolution of 13 major aroma components is followed using GLC as analytical technique. The results show that γ irradiation has a definite influence on aroma production during ripening, although no qualitative effect on the different aroma components individually is found, i.e. on irradiation the aroma level in the apples is lowered, but none of the components is degraded preferentially. It is also shown that the effect of the irradiation process on the aroma production depends on the physiological state of the fruit and on the storage temperature. Aroma production is stimulated in samples irradiated with 50 krad and stored at 23°C and with 200 krad and stored at 3°C. (auth)

24749 STUDIES OF SPROUT INHIBITION OF ONIONS AND POTATOES AND DELAYED RIPENING OF BANANAS AND MANGOES BY GAMMA IRRADIATION. Nair, P. M.; Thomas, P.; Ussuf, K. K.; Surendranathan, K. K.; Limaye, S. P.; Srirangarjan, A. N.; Padwal Desai, S. R. (Bhabha Atomic Research Centre, Bombay). pp 347-366 of Radiation Preservation of Food. Vienna; International Atomic Energy Agency (1973).

From international symposium on radiation preservation of food; Bombay, India (13 Nov 1972). See STI/PUB-317; CONF-721101-.

Sprout inhibition of onions by γ irradiation is influenced by the physiological state of the bulbs and the storage temperature after irradiation. Sprouting is accelerated at low temperatures (10 to 20°C) or when the diurnal temperatures fluctuate widely (30°C max. to 20°C min.). Irradiation at 6 to 9 krad inhibits sprouting during storage under the above conditions only if radiation treatment is given when the bulbs are in the deepest state of rest. Doses above 12 krad cause a transient stimulation of sprouting regardless of the physiological state of bulbs at the time of irradiation. Related biochemical mechanisms are discussed. A dose of 10 krad inhibits sprouting in potatoes and also eliminates the egg and early larval stages of the potato tuber moth. The susceptibility of irradiated potatoes to rotting could be reduced by storage at 15 to 20°C. Irradiation adversely affects indole acetic acid (IAA) synthesis and exogenous application of IAA within 6 hr after irradiation counteracts this effect. Low-dose radiation treatment (25 to 35 krad) extends the shelf-life of five varieties of mangoes by delaying ripening and senescence without affecting fruit quality or major chemical constituents. Browning in fruits receiving higher doses is attributed to activation of polyphenol oxidase. Irradiation of preclimacteric Cavendish bananas at 35 krad results in increased fructose content during the early stages of storage. This fructose accumulation is due to a predominance in the pentose phosphate pathway. A comparative study of the activities of some important enzymes of glycolytic and pentrose phosphate pathways provides support for the idea that there is an overall shift in carbohydrate metabolism towards the pentose phosphate pathway in irradiated bananas. The significance of these findings in relation to the delay in ripening by irradiation is discussed. (auth)

24750 PRESERVATION OF POTATOES BY IRRADIATION AS COMPARED WITH COLD STORAGE. Eisenberg, E. (Soreq Nuclear Research Center, Israel); Lapidot, M.; Mannheim, C. H.; Zimmermann, G. Confructa; 16: No. 5/6, 288-297(1971).

The chemical and sensory properties of potatoes after irradiation with 10 krad and a subsequent storage at +14°C were compared with cold-stored potatoes at +4.5°C. After a storage time of up to 6 months, the irradiated potatoes stored at +14°C showed a 10 to 25% greater vitamin C content, a 50% lower content of reduced sugar and total sugar as well as a 15% greater starch content than the nonirradiated cold-stored potatoes. Irradiated potatoes stored at +14°C showed a 30 to 50% increased browning rate. After frying they were 15 to 20% clearer in color than the non-irradiated cold-stored potatoes, and after boiling and mashing they were 10 to 20% less yellow. Potato crisps from irradiated potatoes stored at +14°C were more sensory than the cold-stored ones. Mashed potatoes from these were less sweet than the cold-stored ones. All results obtained prove to be mathematically significant. (GE)

24751 FREQUENCY AND SPECTRUM OF CHLOROPHYLL MUTATIONS INDUCED BY GAMMA RAYS AND WITH ALKYLATING AGENTS. Bianu, M.; Marki, A. Stud. Cercet. Biol., Ser. Bot.; 22: No. 1, 75-85(1970). (In Russian).

The effects of gamma rays were compared with those of the alkylating agents ethyl methanesulphonate (EMS), N-nitrosomethyl urea (NMU), N,N-bis-(2-chlorethyl) N-O-propylendiamide phosphate (ENDOXAN), and triethylenmelamine (TEM) on dry flax seeds, and cultivars "Raja" and "Concurrent." The oil "Raja" cultivar was more radiosensitive than the fiber "Concurrent" cultivar. Excluding ENDOXAN (inactive in these experiments) and TEM, the other 2 monofunctional alkylating agents were more efficient than gamma rays. The frequency and spectrum of chlorophyll mutations induced by the alkylating agents were significantly different from those induced by gamma rays; under alkylating agents the frequency of albina was reduced in favor of xantha and viridis mutants. The frequency of the albina and viridis mutants increased proportionally with the dose whereas the frequency of xantha decreased. The deficiency of the recessives is similar for all the agents used. The double mutants present an atypic segregation. From the 1045 mutants, 5 proved to be semidominant. (auth)

24752 RADIATION INDUCED STIMULATION IN SACCHARUM SPONTANEUM LINN (WILD SUGAR CANE). Desai, B. M.; Abrahm, V. (Bhabha Atomic Research Centre, Bombay). Stimulation Newslett.; No. 4, 41-42(1972).

Cuttings of S. spontaneum were irradiated with γ rays to a total dose of 100 R to 7.5 kR at 2.8 kR/min. A marked increase in shoot emergence and height was observed after doses from 100 R to 2.5 kR, due to early breaking of dormancy of buds and increase of cell length and/or cell number respectively. (GE)

24753 RADIATION INDUCED GROWTH STIMULATION IN TRADESCANTIA STAMINAL HAIRS. George, K. P.; Nayar, G. G. (Bhabha Atomic Research Centre, Bombay). Stimulation Newslett.; No. 4, 26-28(1972).

Potted plants of T. paludosa and T. clone O_2 were exposed for

10 hrs to 50 to 500 R of ^{60}Co γ rays at dose rates ranging from 5 to 50 R/hr. Inflorescences of similar age were selected at random from 8th to 20th post-irradiation day. In both species, a dose of 50 R caused an increase in cell length of staminal-hairs, while doses of 100 and 150 R caused an increase of cell number. Doses beyond 150 R resulted in a decrease of both cell length and number. (GE)

24754 STIMULATION OF THE GERMINATION OF PINUS SYLVESTRIS POLLEN BY UV RADIATION. II. Zelles, L.; Ernst, D. (Gesellschaft fuer Strahlen- und Umweltforschung mbH, Hanover). Stimulation Newslett.; No. 4, 29-40(1972).

The pollen of P. silvestris was harvested shortly before its dispersal. About 1 mg of pollen was incubated in sucrose solution and illuminated with 1,000 lux. The material was irradiated with uv light of 265 and 254 nm wavelength. After 3 days of incubation, the tube length of 3 × 50 pollen grains was measured. The results revealed a high stimulation of pollen germination at a dose of 2.4 × 10^5 erg/cm^2 of 260 nm uv. This stimulation was observed only with grains germinated in light. In the dark, even small doses were damaging. Following this, the effect of an addition of Actinomycin D in concentrations between 0 and 50 μg/ml was studied. Doses above 10 μg/ml caused a distinct decrease of tube length as compared with the controls. As this antibiotic blocks the formation of mRNA and the stimulating effect of uv can be cancelled out by Actinomycin, one may suppose, that the mechanism of stimulation of pollen tube elongation by uv is probably mediated through the transcription process. (GE)

24755 STIMULATION OF GROWTH IN OCIMUM KILIMANDSCHARICUM BY LOW-DOSE X IRRADIATION. Joseph, B.; Gaur, B. K.; Chadha, M. S.; Patankar, A. V. (Bhabha Atomic Research Center, Bombay). Aust. J. Biol. Sci.; 26: No. 2, 349-355(Apr 1973).

The effect of low-dose x irradiation (125 to 2500 R) of O. kilimandscharicum seeds on germination, growth, and development was studied. Exposure to 1500 and 2500 R brought about marked stimulation in growth and flowering. The increase in foliar growth has resulted in a higher net yield of essential oil and camphor. (auth)

24756 SOME RESULTS OF X-RAY AND NEUTRON APPLICATION TO VINE BREEDING. Coutinho, M. P. (Instituto Superior de Agronomia, Lisbon). Genet. Iber.; 24: No. 1-2, 77-92(1972).

Seeds of the grape, Vitis vinifera, were treated with 500 to 10,000 rads of x radiation and 200 to 8,000 rads of neutrons. Germination was stimulated by x-ray doses up to 5,000 rads; doses above 5,000 rads inhibited germination. The RBE of neutrons was about five times greater than that of x rays. A certain proportion of chlorotic seedlings was observed in both neutron and x-irradiated plants. Mutations for resistance to downy mildew (Plasmopora viticola) were also induced by radiation. (HLW)

24757 EFFECTS OF IONIZING RADIATION ON DEVELOPMENT OF WOUND PERIDERM, SOLANINE CONTENT, AND THE FORMATION OF CARBONYL COMPOUNDS IN POTATO TUBERS. Lee, M. S.; Kim, H. L.; Jeong, J. B. Han'guk Sikp'um Kwahakhoe Chi; 5: No. 1, 65-69(1973).

Effect of various dosages of gamma ray ranging from 0 to 16 krad on wound periderm formation was investigated with aging potato tuber slices (1cm × 2mm) under aseptic condition. Cell division was gradually inhibited with increasing dosage, and completely prevented with 16 krad treatment. Solanine content was not significantly different due to dosages. Gas chromatographic separation of 2,4-dinitrophenylhydrazone precipitate from radiation-induced carbonyl compounds in potato tubers showed that formaldehyde and acetone tended to be increased only with high dosages. (Korean Sci. Abstr.)

24758 NATURE OF RADIATION: INDUCED STIMULATION IN SEEDLING GROWTH. Gaur, B. K.; Joseph, B. (Bhabha Atomic Research Centre, Bombay). Stimulation Newslett.; No. 4, 43-54(1972).

Barley seeds of eight varieties were exposed to 62.5 to 1,000 R of x rays at a dose rate of 25 R/min. Within 2 hrs, the irradiated seeds and controls were sown in sand or soil flats in a greenhouse and the growth was observed at definite intervals. Seven of the eight varieties tested did not respond to the low x-ray doses. Only one variety showed highly significant positive response to almost all the doses. The three growth criteria observed (seedling height, dry and fresh weight) were found to respond differently to radiation, whereby stimulation was higher in fresh and dry weight than in shoot elongation. A decrease in the degree of stimulation occurred with passage of time. Less favorable conditions (sand and higher temperature) lowered the extent of stimulation. (GE)

24759 EFFECT OF HEAT TREATMENT ON BIOLOGICAL RESPONSE AND MUTATION FREQUENCY OF GAMMA IRRADIATED RICE SEEDS. Han, C. Y.; Won, J. L.; Choi, K. T. J. Korean Soc. Crop Sci.; 10: 45-50(1971).

To determine the effect of heat treatment on biological response and mutation rate, rice seeds were heat treated before and after gamma irradiation. At a dose of 20 kR, pre-irradiation heat treatment showed reduced biological damage and increased mutation rate as compared with non-heat treatment. Mutation frequency was increased in post-treatment of heat shock more than in pre-irradiation heat treatment and non-heat treatment. Pre-irradiation heat treatment at 60°C for 30 min markedly reduced the biological damage and increased the mutation rate. Mutation spectrum in heat treatment was different from non-treatment. (Korean Sci. Abstr.)

24760 EFFECTS OF TEMPERATURE AND DURATION OF POST IRRADIATION STORAGE ON SEEDLING HEIGHT OF WHEAT. Han, C. Y.; Kim, C. M.; Sang, Y. J. Korean Soc. Crop Sci.; 10: 73-77(1971).

The experiment was carried out to investigate postirradiation storage effect, which was related to temperature (i.e. at 2°C, 17°C, and 40°C) on wheat seeds, Weibull's Svenno, treated with gamma rays and fast neutrons. Results obtained showed that the seedling height in both radiation sources was decreased with prolongation of storage period, especially when the seeds were treated with high dosage and stored at high temperature (40°C). The results of this trial showed that storage effect was influenced by irradiation dose, temperature, and storage time. (Korean Sci. Abstr.)

24761 RBE OF A 15 MeV ELECTRON BEAM AS A FUNCTION OF DEPTH IN THE FIRST MILLIMETERS OF THE IRRADIATED MEDIUM, DETERMINED BY RADIO-INDUCED CHROMOSOMAL ABERRATIONS IN ONION ROOTS (ALLIUM CEPA). Wambersie, A. (Univ., Louvain, Belg.); Bouharmont, J.; Prignot, M. Atomkernenergie; 21: No. 4, 254-258(1973).

From joint meeting 1972 of the Deutsche Gesellschaft fuer Biophysik e.V. and the Deutsche Gesellschaft fuer Medizinische Physik e.V.; Erlangen, Germany (4 Oct 1972).

Variation of RBE as a function of depth was studied in the first millimeters of the irradiated medium in a 15-MeV electron beam. Chromosome aberrations in onion roots were chosen as biological criterion. The percentages of cells in anaphase and telophase having at least one aberration (fragment) were compared for roots irradiated at 1 mm (at the surface) or at 10.5 mm depth in a Perspex phantom. No quantitative nor qualitative difference was observed in the aberrations produced at 1 and 10.5 mm depth. RBE of the electrons at the surface was found equal to 0.97 ± 0.08 compared to electrons at 10.5 mm depth for a single irradiation. In a second series of experiments, RBE of the electrons was compared at 1 or 10.5 mm depth for two doses (2 × 75 rad) separated by a variable time interval (from a few hrs to 22 hrs). No significant difference was observed in the percentage or type of aberrations. These experiments tend to prove that in the first millimeters of the irradiated medium, the change of the electrons spectrum (or of the LET) is not sufficient to cause a variation of RBE, of the dose-effect curve, or of the kinetics of early recovery that could be of practical importance in radiotherapy. (auth)

24762 APPARENT ABSENCE OF REPAIR REPLICATION IN VICIA FABA AFTER X IRRADIATION. Painter, R. B.; Wolff, S. (Univ. of California, San Francisco). Mutat. Res.; 19: No. 1, 133-137(Jul 1973).

Primary roots were incubated with BUdR and later placed in water containing FUdR and irradiated. DNA was extracted from root tips and neutral gradients prepared from the DNA indicated that DNA molecules with varying amounts of BUdR substitution were formed after irradiation. It was concluded that repair replication did not occur in the bulk of the DNA of Vicia faba root tips after x irradiation. (HLW)

Radiation Effects on Animals

Man

Refer also to abstracts 24685, 24693, 24761, 24852, and 24859.

24763 (AAEC/E-272, pp VIII.1-VIII.3, Paper VIII) BIOLOGICAL EFFECTS OF RADIATION. Watson, G. M. Apr 1973.

From AAEC symposium on environmental and radiological safety aspects of the mining and processing of uranium; Lucas Heights, Australia (9 Dec 1971).

The nature of radiation injury, short-term, delayed, and genetic radiation effects and implications for radiation protection of human populations are briefly outlined. (AT)

24764 RADIATION DOSE TO VARIOUS ORGAN SITES IN A TISSUE-EQUIVALENT HUMAN PHANTOM RESULTING FROM IMPLANTATION OF A PROMETHIUM-147 (^{147}Pm) INTRACAR-

DIAC NUCLEAR PACEMAKER. Arnold, W.; Kereiakes, J. G.; Bahr, G.; Saenger, E. L.; Spickler, J. W. (Univ. of Cincinnati). Amer. J. Roentgenol., Radium Ther. Nucl. Med.; 118: No. 4, 768-776(Aug 1973).

A prototype self-contained intracardiac (IC) pacemaker, using promethium 147 (^{147}Pm), was developed. The IC pacemaker is designed to be implanted transvenously, via the right jugular vein, into the right ventricle and anchored by means of 2 semicircular barbs. One important aspect, before the IC pacemaker is used clinically, is the potential radiation hazard involved when a device of this type is implanted in a human being. Radiation doses to heart muscle and to other organs and tissues were measured using thermoluminescence dosimetry and a tissue-equivalent human phantom. On the basis of present evidence, it seems quite unlikely that the doses (1,350 rads and 883 rads, over a 5 year implantation period, to small volumes of endocardium and myocardium, respectively) delivered at very low dose rates would produce any clinically significant lesion. (auth)

24765 DAMAGE TO MANDIBLE INDUCED BY RADIATION THERAPY OF INTRAORAL CANCER. II. Microradiographic Study. Okuyama, T. (Tokyo Medical and Dental Univ.); Kunimitsu, T.; Mizuno, A.; Adachi, T. Nippon Igaku Hoshasen Gakkai Zasshi; 33: No. 2, 110-120(Feb 1973). (In Japanese).

Bone damage is one of the common and serious complications particularly in the mandible after radiation therapy of intraoral cancer, in spite of the technical improvements and increasing experiences in the radiation therapy. Microradiographic findings of undecalcified ground thin section (approximately 100μ in thickness) of the cortex of mandibulectomized bone that was damaged by radiation therapy, obtained from twelve cases, were described. Microradiography was carried out in contact method by the use of equipment of Philips x-ray diffraction generator, Type PW-1008. The microradiographic changes in damaged bone were observed on the basis of the normal findings. The results are: (1) a number of bizarre resorptions with moth-eaten alcoves that seem to arise from Haversian canals, (2) occasional enlargements of osteocyte lacunae that may be followed by small resorption cavities, (3) hypercalcified Haversian canals with decrease in number of osteocyte lacunae in their Haversian systems, (4) decrease in number and variability in size of Haversian systems, and (5) obscurity in lamellous structure in interstitial lamellae, probably due to hypercalcified process. Above mentioned findings seem to represent two pathologic processes occurred in vital bone cortex; the one, resorptive or decalcified change (1) and (2) and the other, osteosclerotic or hypercalcified change (3), (4) and (5). The former was more prominent in severely damaged materials and the latter is observed in not only the severely damaged materials but also the slightly damaged. The damage to intraosseous fine vessels seems to play an important role in pathogenesis of bone damage induced by radiation. It can be said that irreversible changes develop after the cancer curable dose was administered to adult bone tissue. (auth)

24766 ERYTHROCYTES IN URANIUM MINERS: REVIEW OF CURRENT KNOWLEDGE. Vich, Z. (Inst. of National Health in Uranium Industry, Pribram, Czech.). Sb. Ved. Odbornych Pr., Zavodni Ustav Narodniho Zadravi Uranoveho Prum., Pribram; 5: 9-12(1970). (In Czech).

A brief review is given of knowledge gained so far of numerical, morphological, and biochemical indices of erythrocytes in uranium miners. Metabolic studies are emphasized to be a new, prospective but also more exacting method of broadening current knowledge. Obtained results are believed to be used as tolerance tests for personnel exposed to occupational radiation. (NSA of Czech)

24767 ESTIMATION OF BENEFIT AND RISK OF RADIATION IN CHEST X-RAY MASS SURVEY. Kitabatake, T. (Niigate Univ., Japan); Yokoyama, M.; Sakka, M.; Koga, S. Nippon Kyobu Rinsho; 32: No. 3, 212-217(Mar 1973). (In Japanese).

The number of the chest x-ray mass survey in 1968 collected by the Health Centers was $38,584 \times 10^3$. On this survey, 44,447 cases of active lung tuberculosis were found. Of the 44,447, 38,629 cases seem to be saved from death by medical treatment. Also, 3,029 cases of lung cancer might have been detectable, of which 758 cases seem to survive over 5 yrs. On the other hand, 1.82 leukemias per year or 46 leukemias and 7 lethal cancer cases in the forthcoming 25 years period are expected among this population. Also 140 genetic deaths are estimated until the 10th generation. (auth)

24768 PERMISSIBLE EXPOSURE DOSE OF CHILDREN. Egawa, S. (Teikyo Univ., Tokyo). Shonika Rinsho; 26: No. 5, 646-649(May 1973). (In Japanese).

Biological effects of radiodiagnosis and radiotherapy on man are roughly divided into two types: 1) direct radiation injuries and 2) genetic radiation effects. The maximum permissible dose is not specified particularly for children, nor legally regulated. However, 13% of carcinogenesis in the thyroid was found in the irradiated cases of young adults and children under 20 yrs of age with lymphadenitis compared with 1.6% of carcinogenesis found in the adults according to the report of the International Commission on Radiological Protection (ICRP). The paper discusses in particular radiation effects of x-ray diagnosis on children based on the data of the nation-wide survey conducted by Hashizume et al in 1969. The cases studied consisted of the age group ranging from 0 to 14 yrs old. The estimated total gonad doses were 26.5 mrad, in which 8.1% were boys in the age group (0 to 14 yrs old) while 6.0% were girls. The exposure doses by x-ray diagnosis should be minimized particularly for children, taking into consideration the merit of the x-ray diagnosis, radiation field, and protective measures. Furthermore, the effects of long term irradiation should be clarified. (JA)

24769 CARCINOMA OF THE THYROID IN A PATIENT TREATED WITH RADIOIODINE FOR HYPERTHYROIDISM. Reeve, T. S.; Hales, I. B.; Smith, K. V.; Fowler, N. A. (Royal North Shore Hospital, Sydney). Med. J. Aust.; 1: No. 20, 993-996 (19 May 1973).

External irradiation of the neck has been shown to increase the incidence of thyroid carcinoma in children and young adults. More recently reports have been made noting that carcinoma of the thyroid was observed following treatment of hyperthyroidism with ^{131}I. The case history of a patient dying from thyroid cancer six years after ^{131}I therapy is reported. Thirteen other such clinical situations have been noted in the literature and are briefly reviewed along with the case history being reported. (auth)

24770 RADIOLOGICAL PROTECTION PROBLEMS IN FACTORIES. Burgess, C. D. J. Inst. Nucl. Eng.; 14: No. 2, 51-54 (Mar 1973).

From Meeting of the Institution of Nuclear Engineers; London, England (16 Nov 1972).

The legislation for radiological protection made under the Factories Act, 1961, and the organization used to administer it are briefly described. Reports of incidents and excessive exposures to ionizing radiation notified to H M Factory Inspectorate under the regulations are reviewed, and the areas where additional effort needs to be deployed are indicated. Detailed consideration is given to radiological protection for workers employed on site radiography. (auth)

24771 RADIATION RETINOPATHY FOLLOWING RADIATION THERAPY OF CARCINOMA OF MAXILLARY SINUS. Yoshioka, H.; Kihara, H. (Kurume Univ., Fukuoka). Rinsho Ganka; 27: No. 2, 163-169(Feb 1973). (In Japanese).

Thirty three cases with carcinoma of maxillary sinus treated by radiotherapy were examined with ophthalmoscopy and fluorescein angiography. Radiation retinopathy was found in four cases (12%). These cases were all female and had been treated using a linac. Radiation retinopathy may be more frequently seen in patients treated using a linac than in patients irradiated using x rays or ^{60}Co. The fluorescein angiographic findings revealed that the early changes in this retinopathy consist of localized dilatation, closure of retinal capillaries, microaneurysms, and fluorescein leakages of the affected capillaries. Radiation retinopathy following linac irradiation was similar to those following x ray or ^{60}Co irradiation. The relation between the development of radiation retinopathy following linac irradiation and age, sex, radiation dose, and periods from irradiation to the first ophthalmological examination was not demonstrated. The necessity of fluorescein angiography and the long term follcw-up examination should be emphasized for the early detection of this retinopathy in all cases with carcinoma of maxillary sinus irradiated by a linac. (auth)

24772 CHROMOSOME ABERRATION DOSIMETRY USING HUMAN LYMPHOCYTES IN SIMULATED PARTIAL BODY IRRADIATION. Lloyd, D. C.; Purrott, R. J.; Dolphin, G. W. (National Radiological Protection Board, Harwell, Eng.). Phys. Med. Biol.; 18: No. 3, 421-431(May 1973).

The effect of x irradiation on the yield of transformed cells in culture was studied in human peripheral blood lymphocytes. Aberration yields were obtained for mixed cultures prepared from equal numbers of normal and irradiated lymphocytes and from pure cultures of irradiated cells. Comparison of data from these two types of culture shows that the observed yield ranged from 90% of the expected yield at 50 rad to 11% at 700 rad. Poisson analysis demonstrated that for all doses, cells with high levels of chromosome structural damage were not selectively eliminated. No attempt was made to distinguish between the individual effects of interphase death and mitotic delay. Analysis of the aberration yield data demonstrated an approximately dose-squared relationship for dicentrics. With acentrics, however, the yield is best represented by a quadratic $Y = aD + bD^2$ expression with the "a" term being greater at doses below 100 rad. A D_{37} value of 270 rad was obtained and is consistent with a target size comparable with that of

a chromosome. The implication of this work in the field of dose estimation by chromosome aberration analysis is discussed. (auth)

24773 BIOELECTRICAL BRAIN ACTIVITY IN INDIVIDUALS SUBJECTED TO CHRONIC ACTION OF IONIZING RADIATION. Sosnovskaya, F. M. (Inst. of Industrial Hygiene and Occupational Disease, Moscow). Zh. Nevropatol. Psikhiat.; 71: No. 2, 205-209 (1971). (In Russian).

The results of an EEG study of 78 individuals subjected to the action of small doses of radiation in the range of 10 to 400 R for a period of 5 to 20 yr, with the diagnosis of neurocirculatory dystonia, summarized. The results indicate an absence of marked disorders in the bioelectrical brain activity in the majority of the people examined. Those deviations which were detected were characterized by a weakening of the α-rhythm and definite increase of the slow activity. In some cases there was a tendency to shift to the spontaneous EEG frequencies to more rapid fluctuations. There is a tendency to increase the EEG changes depending on the total doses of radiation and the existence of clinical symptoms of the radiation sickness. (auth)

24774 CHEMICAL RADIOPROTECTIVE SUBSTANCES. Robbe, Y. (Univ., Montpellier, France). Radioprotection; 7: No. 4, 229-251(1972). (In French).

The various mechanisms to which the radioprotecting qualities of different substances can be attributed are reviewed: radiochemical mechanisms, biochemical mechanisms, physiological mechanisms, chelation of certain ions, antimitotic effects, hypoxy, anoxy, and inhibition of the direct oxidation channel. A list of radioprotecting substances is given. (227 references) (FR)

24775 LEAD-210 BLOOD CONCENTRATION AS A MEASURE OF URANIUM MINER EXPOSURE. Blanchard, R. L. (Environmental Protection Agency, Cincinnati). Health Phys.; 25: No. 2, 129-133(Aug 1973).

^{210}Pb concentrations were measured in the blood of 25 uranium miners and compared to the Working Level Month (WLM) exposures estimated from underground atmospheric measurements. The data were normally distributed with a linear correlation coefficient of 0.89. Estimation of cumulative exposures in uranium mines from ^{210}Pb blood concentrations may be possible except in the case of current miners whose blood concentrations are elevated relative to their cumulative exposure. (auth)

24776 MODERN RADIOBIOLOGICAL ASPECTS OF TUMOR THERAPY. Hug, O. (Univ., Munich). Arch. Klin. Exp. Ohren-, Nasen- Kehlkopfheilk.; 205: No. 1, 37-48(1973). (In German).

On the basis of experimental data concerning the cytological effects of ionizing radiation, the various repair and recovery processes are discussed on which the effectiveness of dose fractionation depends. The increasing knowledge of cell kinetics of normal and malignant tissues allows the interpretation of clinical experience on the fraction effect. Furthermore, it may favor the development of tumor specific and perhaps even individual schedules of treatment. (auth)

24777 FOLLOW-UP EXAMINATIONS OF PERSONS IRRADIATED DURING CHILDHOOD IN TUEBINGEN IN THE YEARS 1925-1965 ON ACCOUNT OF BENIGN DISEASES. Gnutzmann, B. Tuebingen, Ger.; Univ. Tuebingen (1971). 89p. (In German).

Three hundred and fifty cases could be followed out of a total of 647 children irradiated on account of benign diseases. In order to improve the statistical evaluation of the results of this study, the theses written by G. von Dessien and A. Rox were also taken into account, as these authors studied the fate of 224 and 430 patients with the same methods. Thus the present investigations are based on a total of 1,301 children patients, and 75.2% of these cases could be followed. The observation period was 21.6 yrs on the average. No signs of irradiation-induced changes of the eyes, especially formation of cataracts, or of leukemia were found. One female patient developed a mammary carcinoma 27 yrs after irradiation of both armpits with 400 R each, due to sudoriparons abscesses. Seven per cent of 543 patients who had been irradiated in the cervical region were found to suffer from a goiter, whereas only 4.7% of the remaining 274 patients developed a struma. But it cannot be said for sure that there is a clear relationship between irradiation of the cervical region and development of a struma. With regard to changes of the locomotor system that were observed in eight cases, a relationship between irradiation therapy and the disease can be assumed for one case only, i.e. that of a woman whose left palm and little finger were not fully developed. A shortening of life due to the irradiation therapy could not be stated for lack of an adequate control group. No significant deviation from the usual sex ratio was found in the offspring of irradiated men, whereas the number of female children born to irradiated women was significantly higher in terms of statistics. Sixteen out of a number of 778 children of irradiated patients showed innate malformations. Fifty premature deliveries and stillbirths were recorded but this figure cannot be stated to be indicative of possible genetic hazards, as the number of deliberately hidden abortions is not known. (GE)

24778 IONIZING RADIATION AND ITS EFFECT ON SEXUAL GLANDS, PREGNANCY, AND FETUS. Marinova, G. Akush. Ginekol.; 11: 161-167(1972). (In Bulgarian).

24779 RELATIONSHIP OF RADIATION-INDUCED DICENTRIC YIELD TO CHROMOSOME ARM NUMBER. Savage, J. R. K.; Papworth, D. G. (Medical Research Council, Harwell, Eng.). Mutat. Res.; 19: No. 1, 139-143(Jul 1973).

Using human chromosomes as a standard, a model was developed to describe the relationship of a radioinduced dicentric yield to chromosome arm number. For a fixed nuclear size, and a given radiation dose, the contact interface model predicts a linear increase in interchange yield with increase in arm number, and the magnitude of the predicted changes is not inconsistent with those actually observed. The model accounts for, and has been used to predict, the low dicentric:centric ring ratios observed in a variety of organisms. (HLW)

Vertebrates

Refer also to abstracts 24682, 24727, and 24882.

24780 (AD-756609) POSTIRRADIATION PERFORMANCE OF MINIATURE PIGS AS MODIFIED BY TASKS. Chaput, R. L.; Barron, E. L. (Armed Forces Radiobiology Research Inst., Bethesda, MD). Jun 1972. 24p. (AFRRI-SR-72-10). NTIS.

The postirradiation performance of miniature swine trained to work a shuttlebox problem was compared to that of miniature pigs trained to work a visual discrimination problem. The pigs were whole-body exposed to a γ ray field produced by the AFRRI-TRIGA reactor operated in the pulse mode (incident neutron to gamma ratio of 0.06) and received midline tissue doses to the brain of 1200 to 3300 rads. The major difference in performance occurred during the first 30 minutes after irradiation. At the doses used in this study, discrimination-trained pigs experienced a more severe and prolonged period of early temporary performance decrement than did the shuttlebox-trained pigs. The ED50 or 50 percentile midbrain dose for early performance decrement was calculated to be 1870 and 2380 rads for the discrimination-trained and shuttlebox-trained pigs, respectively. (auth)

24781 (AD-757661) RELATIONSHIP OF BLOOD-BRAIN BARRIER DAMAGE TO SURVIVAL TIME AFTER ACUTE RADIATION INJURY. Wyant, D. E.; Kabal, J.; Baum, S. J.; Parkhurst, L. J. (Armed Forces Radiobiology Research Inst., Bethesda, MD). Nov 1972. 13p. (AFRRI-SR-72-18). NTIS.

Whether a relationship exists between alterations of the blood-brain barrier (BBB) and the survival time of rats exposed to supralethal irradiation was investigated. BBB alterations were produced by injection of glycerol, mercuric chloride, or by lymphatic cervical blockade. Animals were subsequently exposed to a supralethal dose of radiation, and the survival times of various groups were compared. The production of BBB alterations prior to irradiation did not influence the survival time of rats after exposure to supralethal doses of radiation suggesting that BBB damage may bear no direct relationship to the survival time after radiation injury. (NTIS)

24782 (AD-759016) FACTORS AFFECTING THE PERFORMANCE OF PRIMATES FOLLOWING A 2700-RAD PULSED DOSE OF IONIZING RADIATION. Brown, G. C.; Curran, C. R.; Verrelli, D. M.; Allen, S. J.; Barnes, D. J. (Armed Forces Radiobiology Research Inst., Bethesda, MD). Aug 1972. 21p. (AFRRI-SR-72-14). NTIS.

The performance of eight monkeys (Macaca mulatta), trained to operate a primate equilibrium platform (PEP), was tested following a single pulse, whole-body 2700-rad (plus or minus 200 rads) dose of neutron-γ radiation at the AFRRI-TRIGA reactor (n/g = 0.5:1, pulse half-width of 50 msec). The results were compared to: PEP-trained animals exposed to a 2500-rad pulse of neutron-gamma radiation at the White Sands Missile Range fast burst reactor (n/g = 9:1, pulse half-width of 40 microsec), and animals trained at the Armed Forces Radiobiology Research Institute (AFRRI) to perform a simple discrete avoidance task and then irradiated (2800 rads) in the AFRRI-TRIGA reactor. The two groups of animals exposed in the higher γ field of the TRIGA reactor exhibited a behavioral decrement soon after irradiation which was more severe than the decrement observed in animals exposed to the higher neutron field of the White Sands reactor. Stimulus response differences in the behavioral tasks employed were manifested in a slower recovery rate for the PEP-trained animals exposed in the TRIGA reactor compared to the AFRRI animals trained to perform the discrete avoidance task and irradiated in the same reactor. (auth)

24783 (AD-759017) PERFORMANCE OF THE MONKEY (MACACA MULATTA) AFTER TWO 2500-RAD PULSES OF MIXED GAMMA-NEUTRON RADIATION. Young, R. W.; McFarland, W. L. (Armed Forces Radiobiology Research Inst., Bethesda, MD). Nov 1972. 30p. (AFRRI-SR-72-19). NTIS.

Eighty-five male monkeys maintained in primate restraining chairs were trained to criterion performance on a shock avoidance visual discrimination task. The subjects were then irradiated with either a single 5000-rad pulse or two 2500-rad (midline tissue dose) pulses of mixed γ-neutron radiation (neutron to γ ratio of 0.4). The second 2500-rad dose was delivered after intervals of 20, 30, 40, 60, 180, 270, or 360 minutes. Performance was monitored continuously, and data are reported for animals irradiated with midline tissue doses of 2500 rads, 5000 rads, and 2500 rads followed by 2500 rads. Subsequent to a single 2500-rad irradiation, 75% of the subjects exhibited performance decrements. For subjects irradiated with two 2500-rad pulses, the degree of performance decrement was not as great as that observed for subjects irradiated with a single 5000-rad pulse, unless the 2500-rad pulses were separated by an interval of approximately 40 minutes. Despite the decreased behavioral decrement for the animals with fractionated doses, no difference was observed in survival times from those of subjects irradiated with a single dose of 5000 rads. (auth)

24784 (AD-759340) PERFORMANCE OF PRIMATES FOLLOWING EXPOSURE TO PULSED WHOLE-BODY GAMMA-NEUTRON RADIATION. Curran, C. R.; Young, R. W.; Davis, W. F. (Armed Forces Radiobiology Research Inst., Bethesda, MD). Jan 1973. 31p. (AFRRI-SR-73-1). NTIS.

Eighty-eight monkeys (Macaca mulatta) were trained to perform a shock motivated visual discrimination task and were exposed to a single supralethal dose of pulsed γ-neutron radiation. The postirradiation performance of these animals is presented in a manner that facilitates group comparisons of performance following doses of approximately 1100, 1700, 2600, 4900, 8600, or 15,200 rads. At these dose levels, group performance declined within minutes after exposure. For some subjects, the decline was so severe that the animals appeared comatose. The frequency with which a behavioral decrement was observed and the severity of the initial decrement appeared to be dose dependent. After the initial decrement, most animals at least partially regained their ability to perform the discrimination task. Performance was generally maintained at recovery levels until shortly before death. Factors that appeared capable of modifying observed postirradiation behavior include the γ-neutron ratio of the radiation source and the nature of the behavioral task employed. (auth)

24785 (AEC-tr-7444) RADIOBIOLOGY. Translated from Radiobiologiya; 13: No. 2, 163-320(1973). 203p. Dep. NTIS $7.60.

Separate abstracts were prepared for the 35 papers presented in this translation. (ERB)

For abstracts of individual papers see: 24683–24686, 24697, 24732–24736, 24786–24806, 24844–24846, and 24879.

24786 (AEC-tr-7444, pp 1-20) FORMATION OF CHROMOSOME ABERRATIONS DURING THE IRRADIATION OF CELLS AT VARIOUS STAGES OF THE MITOTIC CYCLE. Luchnik, N. V. (Scientific Research Inst. of Medical Radiology, Obninsk, USSR). Translated from Radiobiologiya; 13: No. 2, 163-177(1973).

A detailed study of the principles of action of radiation on chromosomes in various stages of the cell cycle attracts little attention from researchers, although such a study promises valuable information. Data were accumulated that cannot be explained by the classical theory, which calls for a radical reexamination of it. The hypothesis that there are two previously unknown stages of intermolecular verification in the cell cycle is discussed. During the first verification, which occurs before synthesis, there is an exchange of genetic information between subunits of the original chromosome. The second verification occurs before mitosis and involves a comparison of new and old structures. The experimental facts are well explained within the framework of this hypothesis. (tr-auth)

24787 (AEC-tr-7444, pp 21-27) ACTIVITY OF DNA POLYMERASE AND DNAases IN THE DYNAMICS OF ACUTE RADIATION SICKNESS. Moskaleva, E. Yu.; Mazurik, V. K. (Inst. of Biophysics, Moscow).

Depending on the dose (100 to 900 R), an inhibition of the activity of DNA polymerase and an activation of DNAase II were observed in the hematogenic organs of rats. The D_{37} for bone marrow DNA polymerase was about 100 R, for the thymus gland and spleen about 500 R. Changes in the enzyme activity were closely correlated with the decrease in DNA in the organs. The DNA polymerase activity was restored by the fifth day in the bone marrow and thymus gland, by the 15th day in the spleen, and from the 15th to the 30th day it was two to three times above normal. On the 5th, 15th, 20th, and 27th days, a complete coincidence of the direction of the changes in the DNA polymerase and DNAase activities was noted. (tr-auth)

24788 (AEC-tr-7444, pp 28-35) EFFECT OF INHIBITION OF $(Na^+, K^+)Mg^{2+}$- AND Ca^{2+}-DEPENDENT ATPase OF THYMOCYTE NUCLEAR MEMBRANES DURING X IRRADIATION. Liu, L. D. (Inst. of Biological Physics, Pushchino, USSR). Translated from Radiobiologiya; 13: No. 2, 184-189(1973).

The influence of x irradiation on the release of $(Na^+, K^+)Mg^{2+}$- and Ca^{2+}-dependent ATPases from the nuclear membrane and their activity at the surface of the nuclear membranes of rat thymocytes was studied. It was shown that irradiation does not cause release of the enzymes from the structure of the nuclear membranes even in the case of irradiation at a dose of 200 R; when isolated nuclei are irradiated, and even more distinctly in the case of irradiation in vivo, there is a decrease in the activity of both enzymes, contained in the nuclear membrane, which can be reliably determined in the case of irradiation at a dose of 0.5 kR and above. In the irradiated membrane (1 kR) a decrease in the ability of the enzyme to respond to optimum concentrations of ATP is observed. The possible mechanisms of the radiation change in the activity of the enzymes of the nuclear membrane are discussed. (tr-auth)

24789 (AEC-tr-7444, pp 36-44) EFFECTS OF IONIZING RADIATION ON THE ACTIVE TRANSPORT OF SODIUM IN MULTICELLULAR BIOLOGICAL MEMBRANES. Communication 1. Changes in the Activity of Sodium on the Inner Surface of Frog Skin in the Case of Its Irradiation In Vivo and In Vitro. Nadareishvili, K. Sh.; Sanaya, T. V. (Inst. of Physiology, Tbilisi, USSR). Translated from Radiobiologiya; 13: No. 2, 190-196(1973).

The effects of radiation on the dynamics of the change in the sodium activity on the inner surface of frog skin were studied with the aid of cation-selective electrodes. Complete inhibition of the active transport of sodium immediately after irradiation of isolated tissue requires doses of the order of one million R and above, whereas irradiation of the skin in vivo at a dose of 20 kR induces substantial changes in the active transport 24 hrs after the influence. Under the same conditions, a dose of 100 kR almost entirely inhibits the active transport of sodium five days after irradiation, while at 300 kR the same effect is already observed after 2.5 hrs. It is suggested that the direct damage to the structure of the membranes and enzymes responsible for the active transport of sodium is not the primary, starter link in the radiation damage to apolar frog skin cells. Possible mechanisms of the substantial differences detected in the case of irradiation of skin in vivo and in vitro are discussed. (tr-auth)

24790 (AEC-tr-7444, pp 45-50) REDOX PROPERTIES OF ARYL DERIVATIVES OF TRIAZOLE AND TETRAZOLE AND THEIR INFLUENCE ON THE FREE RADICAL STATES OF ANIMAL TISSUES. Chebotarev, E. E.; Kulyabko, P. N.; Kuz'menko, V. A.; Fedorchenko, V. I. (Inst. of Microbiology and Virology, Kiev). Translated from Radiobiologiya; 13: No. 2, 197-201(1973).

It was shown that aryl derivatives of triazole and tetrazole possess donor properties. When they are introduced into the animal organism, they perform the functions of antioxidants. However, no strict correlation is detected between the physicochemical properties of the preparations and their radioprotective effectiveness. It was established that a correlation exists between the effectiveness of protection by aryl derivatives of tetrazoles and their ability to normalize free radical states of the organs of irradiated animals 3 to 4 hrs after irradiation. (tr-auth)

24791 (AEC-tr-7444, pp 51-56) CHANGES IN THE COLONY FORMING ABILITY OF HEMATOGENIC ORGANS IN MICE AT VARIOUS PERIODS AFTER IRRADIATION UNDER CONDITIONS OF PROTECTION WITH CYSTAPHOS. Koval'chuk, L. V.; Zherebchenko, P. G.; Petrocv, R. V.; Shevchenko, A. N. (Inst. of Biophysics, Moscow). Translated from Radiobiologiya; 13: No. 2, 202-205(1973).

In the spleens of $(CBAxC_{57}B1)F_1$ mice, protected with cystaphos, the number of colony-forming units (CFU) on the seventh day after irradiation was reduced several-fold in comparison with the initial level. On the 14th day, a superaccumulation of stem elements was observed, followed by a return to the initial values on the 30th day. The effect of superaccumulation was more pronounced at a dose of cystaphos of 2 mmoles/kg than at a dose of 3 mmoles/kg. A less profound drop in the number of CFU on the seventh day after irradiation and a weaker increase on the 14th day were noted in the bone marrow of mice protected with cystaphos, in comparison with the spleen. (tr-auth)

24792 (AEC-tr-7444, pp 69-75) ROLE OF RADIATION BIOCHEMICAL MECHANISMS IN THE DEVELOPMENT OF RADIATION DAMAGE TO THE GENETIC APPARATUS OF ANIMAL CELLS. Grigorovich, N. A.; Monastyrnaya, P. L.; Aleksa, T. F. (Scientific Research Inst. of Oncology and Medical Radiology, Minsk). Translated from Radiobiologiya; 13: No. 2, 216-220 (1973).

It was shown in experiments in vitro and in vivo that radiation damage to the chromatin of the cell nuclei after irradiation at doses up to 10,000 rad is probably due to radiobiological mechanisms, based on the change in the permeability of the lysosomal membranes, release of the nucleases and cathepsins contained in them, and the influence of the latter on the components of the chromatin. The radiation-chemical mechanisms of damage to the chromatin under these conditions evidently play only a secondary role. (tr-auth)

24793 (AEC-tr-7444, pp 76-80) INFLUENCE OF THE THERAPEUTIC DNA ON RADIATION DESTRUCTION OF CELLS OF RADIOSENSITIVE TISSUES OF RATS. Tereshchenko, O. Ya.; Golyshev, E. P. (Inst. of Biophysics, Moscow). Translated from Radiobiologiya; 13: No. 2, 221-224(1973).

The influence of heterologous DNA, administered to rats after total irradiation at a dose of 600 R, on the level of the radiation destruction of cells in the organism was investigated. This index was estimated according to the amount of DNA, preliminarily labeled with ^{14}C-thymidine, decomposed in the organism. The level of decomposition of DNA was judged according to the amount of ^{14}C-thymidine excretable with the urine. It was established that the introduction of DNA lowers the degree of the early radiation destruction of cells (death of the cells in the interphase). (tr-auth)

24794 (AEC-tr-7444, pp 81-86) INFLUENCE OF CHEMICAL PROTECTION ON THE POSTRADIATION RECOVERY OF CRITICAL SYSTEMS OF THE MAMMALIAN ORGANISM. Kovalev, V. P.; Plotnikova, E. D.; Eidus, L. Kh. (Inst. of Biological Physics, Pushchino, USSR). Translated from Radiobiologiya; 13: No. 2, 225-229(1973).

The influence of cystaphos on the postradiation recovery of the mouse organism after whole-body γ irradiation in the hematogenic and gastrointestinal forms of death was studied by the method of two irradiations. The action of the protector is manifested in a sharp reduction of the residual lesion within the first day after irradiation, without any change in the subsequent course of the recovery process. In the light of the data obtained earlier on the cellular nature of the individual stages of recovery, these results mean that the action of the protector is accomplished either by reducing the original damage during irradiation or by an intensification of recovery processes in the cell without affecting the rate of subsequent proliferation of surviving stem cells of the corresponding system. (tr-auth)

24795 (AEC-tr-7444, pp 87-92) POTENTIATION OF THE RADIOPROTECTIVE ACTION OF CYSTAMINE BY HEPARIN. Lukashin, B. P.; Dzharak'yan, T. K. (Military-Medical Academy, Leningrad). Translated from Radiobiologiya; 13: No. 2, 230-234 (1973).

A substantial potentiating action of heparin on the radioprotective effect of cystamine in a broad range of doses was detected in experiments on mice and rats, 20 to 150 and 20 to 45 mg/kg, respectively. The potentiating effect of heparin was detected at doses of irradiation inducing pancytopenic (700 to 750 R) and intestinal (1000 R) syndromes, both according to survival and according to the number of endogenous colonies in the spleen. (tr-auth)

24796 (AEC-tr-7444, pp 93-98) INFLUENCE OF ANTIINFLAMMATORY AGENTS ON THE EARLY DEATH OF ANIMALS SUBJECTED TO GAMMA IRRADIATION IN SUPERLETHAL DOSES. Kudryatsev, V. D.; Uklonskaya, L. I.; Suchkevich, L. N.; Cherkasov, V. F. (Scientific Research Inst. of Medical Radiology, Obninsk, USSR). Translated from Radiobiologiya; 13: No. 2, 235-238(1973).

An attempt was undertaken to influence the acute intestinal death (third to fifth day) of rats and mice, irradiated in superlethal doses, with the aid of the antiinflammatory preparation butadione. The therapeutic administration of butadione over a five-day period after irradiation (5 mg/kg three times a day intraperitoneally) lowered the death rate of the animals during the period of intestinal death. A more distinct positive therapeutic effect of butadione was detected in the case of joint use with tetraoleane. (tr-auth)

24797 (AEC-tr-7444, pp 99-104) SOME PECULIARITIES OF THE ORIENTING REACTION IN THE ONTOGENESIS OF RABBITS IRRADIATED WITH IONIZING RADIATION DURING EMBRYOGENESIS. Airapetyants, M. G.; Matyushkina, O. I. (Inst. of Higher Nervous Activity, and Neurophysiology, Moscow). Translated from Radiobiologiya; 13: No. 2, 239-243(1973).

The initiation and ontogenetic development of the orienting reaction in rabbits irradiated with ionizing radiation at various periods of intrauterine development were investigated. Among the irradiated animals an earlier appearance of the orienting reaction to distant stimuli was detected, and a difference in the quantitative and qualitative peculiarities of the course of the autonomic and motor components of the reaction between irradiated and intact animals was observed. A dependence of the changes in the course of the reactions on the period of the influence of the pathogenic factor was demonstrated. In animals irradiated during the fetal period, an inextinguishable orienting reaction was detected. (tr-auth)

24798 (AEC-tr-7444, pp 105-111) SEASONAL FLUCTUATIONS OF THE RADIOSENSITIVITY OF MICE. Darenskaya, N. G.; Kuznetsova, S. S.; Pravdina, G. M. (Inst. of Biophysics, Moscow). Translated from Radiobiologiya; 13: No. 2, 244-248 (1973).

An investigation was made of 3500 noninbred male mice, 2 to 3 months of age. The dose versus effect dependence was determined monthly over a period of two years according to the death of the mice in 30 days. The value of $LD_{50/30}$ varied around the average annual level (499 R) from 653 and 688 R in March and August to 368 and 345 R in February and May, respectively. In the case of irradiation in the summer, in comparison with the winter months, death of the mice occurred at earlier periods. (tr-auth)

24799 (AEC-tr-7444, pp 112-118) RADIATION LESION OF GUINEA PIGS IN IRRADIATION AT VARIOUS DOSE RATES. Koznova, L. B.; Ostroumova, L. M. (Inst. of Biophysics, Moscow). Translated from Radiobiologiya; 13: No. 2, 249-254(1973).

The biological effects of brief and prolonged γ irradiation were compared on experiments on guinea pigs at the dose rates 263, 0.27, and from 0.05 to 0.17 R/min. A study of the dose versus effect dependence permitted a determination of the values of $LD_{50/30}$, which were 307, 588, and 667 R, respectively. The responses of the hematogenic system were also studied. It was shown that restoration of the investigated indices after prolonged irradiation occurs earlier than after brief irradiation. (tr-auth)

24800 (AEC-tr-7444, pp 135-138) CORRELATION BETWEEN INTERPHASE DEATH OF CELLS AND THE AMOUNT OF POLYDEOXYNUCLEOTIDES IN THE SPLEENS OF IRRADIATED ANIMALS. Semina, O. V. (Scientific Research Inst. of Medical Radiology, Obninsk, USSR). Translated from Radiobiologiya; 13: No. 2, 268-271(1973).

It has been shown that the number of cells that died in the spleens of mice irradiated at a dose of 500 R increases during the first 5 hrs after irradiation without a latent period, whereas the increase in the level of polydeoxynucleotides (PDN) in the tissue is preceded by a certain latent period, lasting about 2 hrs. It is suggested that the process of interphase death of cells preceded the appearance of PDN in the tissues. (tr-auth)

24801 (AEC-tr-7444, pp 142-145) INVESTIGATION OF THE QUANTITATIVE CONTENT OF ADENYLIC NUCLEOTIDES IN THE SUBMAXILLARY LYMPH NODES OF RATS SUBJECTED TO VARIOUS DOSES OF WHOLE-BODY X IRRADIATION. Khanson, K. P.; Baisakhotov, R. (Central Scientific Research Roentgenoradiological Inst., Leningrad). Translated from Radiobiologiya; 13: No. 2, 274-277(1973).

Substantial changes in the adenylic system of the submaxillary lymph nodes were detected 24 hrs after whole-body x irradiation of rats at doses from 100 to 1000 rads. Sublethal doses of radiation (up to 600 rad) cause a redistribution in the pool of free adenine nucleotides: a decrease in the fraction of ATP and a simultaneous increase in ADP and AMP with an unchanged total content of nucleotides in the tissue. In the case of absolutely lethal doses of irradiation (800 and 1000 rad), a sharp decrease in the concentration of all the fractions of adenine nucleotides (ATP, ADP, and AMP) is observed; in this case the ratios among the components remain close to normal. (tr-auth)

24802 (AEC-tr-7444, pp 146-150) CORRELATION OF THE AMOUNTS OF PROTEIN AND NONPROTEIN THIOLS AND THE LEVEL OF RADIOSENSITIVITY IN LOACH EGGS DURING CLEAVAGE. Smirnova, I. B.; Latis, R. V. (Inst. of Developmental Biology, Moscow). Translated from Radiobiologiya; 13: No. 2, 277-280(1973).

The relationship of the periodically varying radiosensitivity of loach eggs during cleavage to the total amount of protein and nonprotein thiols was investigated. The thiol level was determined by amperometric titration of homogenates of the eggs at different stages of cleavage. The radiosensitivity of the eggs was judged according to the survival of the embryos 24 hrs after irradiation at various periods after fertilization. A positive correlation of

the radiosensitivity with the thiol level in the egg at the moment of irradiation was demonstrated. (tr-auth)

24803 (AEC-tr-7444, pp 151-154) CHANGE IN RADIATION LESION OF THE INTESTINE UNDER THE INFLUENCE OF SODIUM CITRATE AND HEPARIN. Nesterenko, V. S.; Bandurko, L. N.; Cherkasov, V. F.; Brodskii, R. A. (Scientific Research Inst. of Medical Radiology, Obninsk, USSR). Translated from Radiobiologiya; 13: No. 2, 280-283(1973).

It was shown that the administration of sodium citrate and heparin to mice irradiated at a dose of 1000 R has a normalizing influence on the morphological and functional indices of the small intestine. The survival of the irradiated animals during the period of "intestinal death" is increased. (tr-auth)

24804 (AEC-tr-7444, pp 176-178) INFLUENCE OF DIMETHYL SULFOXIDE AND COMBINATIONS OF IT WITH OTHER PROTECTORS ON THE LEVEL OF SULFHYDRYL GROUPS IN THE MOUSE SPLEEN. Murskikh, A. P. (Ukrainian Inst. for the Advanced Training of Physicians, Kharkov). Translated from Radiobiologiya; 13: No. 2, 298-300(1973).

An increase in the thiol content after the introduction of dimethyl sulfoxide (DMSO) and combinations of it with other protectors was detected in experiments on white mice; data on a similar action of cystamine (CA) and serotonin (S) were confirmed. It is suggested that the thiol increasing effect of the investigated protectors is mediated by close mechanisms. (tr-auth)

24805 (AEC-tr-7444, pp 179-182) CHANGE IN THE LEVEL OF ENDOGENOUS THIOLS IN BONE MARROW CELLS AND THEIR RADIOSENSITIVITY UNDER THE INFLUENCE OF HYPOTHERMIA. Petrosyan, E. P.; Simakov, V. I.; Yarmonenko, S. P.; Polyashov, A. N.; Rubinshtein, I. B. (Inst. of Experimental and Clinical Oncology, Moscow). Translated from Radiobiologiya; 13: No. 2, 300-302(1973).

A parallel study of the change in the level of endogenous thiols of the bone marrow after 30 min and the number of myelokaryocytes four days after irradiation at a dose of 500 rad was made in experiments on rats subjected to local hypothermia of the hind limbs. It was established that lowering the temperature of the bone marrow to 5 to 12°C is accompanied by a 43% increase in the level of endogenous thiols and a 35 to 40% decrease in the degree of bone marrow destruction in comparison with the control. A brief description of a semiautomatic apparatus for amperometric determination of thiol groups is cited. (tr-auth)

24806 (AEC-tr-7444, pp 189-192) INTRAVITAL PHOTOMETRY OF THE ULTRAVIOLET FLUORESCENCE OF ORGANS OF IRRADIATED ANIMALS BY MEANS OF A CONTACT MICROSCOPE. Brumberg, I. E. (Military-Medical Academy, Leningrad). Translated from Radiobiologiya; 13: No. 2, 306-308(1973).

The possibility of using a contact microscope for the quantitative evaluation of the change in the intensity of the ultraviolet fluorescence of organs, due to the action of ionizing radiation, was demonstrated in experiments on irradiated animals. (tr-auth)

24807 (COO-3085-25) ENZYMIC AND MORPHOLOGICAL DIFFERENTIATION OF RAT LIVER. Greengard, O. (Harvard Medical School, Boston, Mass.; New England Deaconess Hospital, Boston, Mass.; Cancer Research Inst.). 1973. 26p. Dep. NTIS $3.50.

Methods are described for the study of various enzymes in the developing liver of the rat fetus in relation to the subcellular morphology of the liver. Pathological alterations in enzymic differentiation were also studied. The levels of some liver enzymes were determined in postnatal rats that had been x-irradiated or had received a tumor implant at the age of ten days. Both conditions enhanced the accumulation of tryptophan oxygenase. Irradiation inhibited the expected rise in glucokinase but not in ornithine aminotransferase activity. Results of experiments indicated that periods of explosive enzyme synthesis were not necessarily reflected in changes in the cytology of the liver or the fine structure of the hepatocytes. (HLW)

24808 (UCB-34-P-82-15) ELECTROPHYSIOLOGICAL AND BIOCHEMICAL STUDIES OF THE EFFECTS OF RADIATION ON BRAIN ACTIVITY AND DEVELOPMENT. Progress Report, November 1970-July 31, 1973. Timiras, P. S. (California Univ., Berkeley). 1973. Contract AT(04-3)-34. 15p. Dep. NTIS $3.00.

Research on the effects of x radiation on neurotransmission in the developing rat brain included an investigation of whether the morphological and electrophysiological deficits observed in x-irradiated rats were mediated by alterations in the development of neurotransmission; a study of whether low doses of x radiation alter neurotransmission; and the use of data from x radiation studies as an experimental tool through which to better understand normal maturation of neurotransmitter function and its implications to over-all CNS competence. Experiments in progress are concerned with effects of x radiation on norepinephrine, serotonin, and dopamine content in various brain regions of the developing rat. Five publications and titles of three papers submitted for publication are listed. (HLW)

24809 (UCD-34-P-187-3-A) HEMATOPOIETIC REPOPULATION FOLLOWING IRRADIATION INJURY. Progress Report, September 1, 1972-June 15, 1973. Lewis, J. P. (California Univ., Davis). 1973. Contract AT(04-3)-34. 10p. Dep. NTIS $3.00.

Studies on x-irradiated CAF_1 female mice confirmed previous findings that the $LD_{50/30}$ dose for these mice is 750 R and that following a $LD_{100/30}$ dose of x radiation half the animals are protected from radiation death by injection of 25,000 syngenic bone marrow cells. A radioimmunoassay method was modified for the measurement of thrombopoietin in the blood serum of mice, and changes in thrombopoietin levels during the 10-day period following exposure to x radiation were measured. Changes in serum erythropoietin levels, granulocyte stimulation factor, and megakaryocyte content in the blood of irradiated mice were also studied. (CH)

24810 (UCLA-12-919, pp 94-98) LEUKEMIA BIOLOGY. 1973.

In annual progress report for the period ending June 30, 1973.

Mouse thymus glands were γ-irradiated in vivo and transplanted to thymectomized syngeneic hosts that were inoculated with virus-accelerated AK lymphoma. The irradiated grafts developed lymphoma but the incidence was lower and the latent period longer than in non-irradiated control grafts. Irradiation of grafts exposed to lymphoma filtrate in vitro and in vivo inhibited the ability of the filtrates to produce lymphoma. Progress is also reported on the following projects: relationships of immune responses in AKR mice to the development of spontaneous leukemia; the effect of endotoxin on colony-stimulating factor release from granulocytes and monocytes in vitro; granulocyte-monocyte colony forming capacity of mouse bone marrow; development of lymphoma in the mouse thymus; single cell transplants of gross virus-induced lymphomas; and tumor-virus relationships in gross virus-induced mouse lymphomas. (HLW)

24811 (UCLA-12-919, pp 122-125) CELLULAR AND MAMMALIAN STUDIES IN RADIATION BIOLOGY. 1973.

In annual progress report for the period ending June 30, 1973.

Cytotoxic antibodies from patients with cervical epidermoid carcinoma inhibited colony formation by six malignant cell lines; radiotherapy did not inhibit this beneficial humoral response. Cytosine arabinoside and methotrexate, inhibitors of DNA synthesis, were shown to induce morphologic differentiation in a malignant murine neuroblastoma line. Effects of antibiotics and cellular differentiation on repair of radioinduced single strand DNA breaks in human and murine cells were studied. Extensive hematopoiesis in peripheral bone marrow occurred following an increase in ambient temperature. This phenomenon of thermal bone marrow expansion will now allow bone marrow manipulations such as regional hypoxia and circulatory shunts; fractionated irradiation experiments were conducted on bone marrow following this treatment. Repair of low dose x-radioinduced DNA damage in human epidermoid carcinoma cells were also studied. (HLW)

24812 TOPOGRAPHIC INVESTIGATION OF THE CUTANEOUS VASCULAR SYSTEM OF MICE BY MEANS OF COLLOIDAL SOOT SUSPENSIONS AFTER IRRADIATION WITH UV AND X RAYS. Ketels-Harken, H. Hamburg; Univ. Hamburg (1971). 62p. (In German).

Thesis.

A method for visualization of an enhancement of vascular permeability by deposits in the vascular wall or by intraluminal deposits of India-ink particles was tested on female NMRI albino mice. Twenty-four hours after mechanical depilation, the animals were subjected to different doses of uv light or to x irradiation of 75,000 R. Vascular labeling was done by i.v. injection of a colloidal soot suspension at different times following irradiation. The animals were sacrificed at different times within 2 hr after application of India-ink and the skin of the irradiated area was prepared as a whole for microscopical investigation. The increase in the permeability observed after a one-min exposure to uv light was found to be similar to a delayed vascular reaction. Various doses of uv light did not show a different deposition pattern in the microscopic picture within the first 2 hr. After a period of 24 hr, an exposure of more than 30 sec. was found to produce crust formation in the irradiated area, without any labeling of the sub-epidermal plexus. The radioreactions after uv and x ray exposure were found to continuously increase with the time of exposure, affecting to an increasing extent the deeper layers and larger vessels of the skin and hypodermic layers. After a period of 24 hr, almost identical

deposition patterns were found for both types of irradiation. As far as could be judged from the results, the labeled vessels seem to belong to the venous system. The findings are discussed with regard to the possible mode of action of the irradiation. (GE)

24813 EFFECT OF IONIZING RADIATIONS UNDER O_2 OVERPRESSURE ON THE GLYCOGEN AND DPN LEVEL IN THE LIVER AND SERUM OF RATS. Lanz, G. Heidelberg; Univ. Heidelberg (1972). 27p. (In German).

Thesis.

Wistar rats weighing 120 to 150 g were used for the experiments. The overpressure treatment with 3 atm. was performed in the Heidelberg chamber; for the irradiation a ^{60}Co telecurie device was used. In different series, the influence of a 3 day starvation or of treatment with ^{131}I and Thybonsup(R) was studied. The oxygen overpressure initially caused a decrease of the metabolic rate followed by an enhancement. After fasting, the values were depressed immediately after the oxygen treatment. In the case of radioiodine a depression was found, Thybonsup(R) showed its catabolic effect. The same decrease of the glycogen and DPN level was found post-irradiation. After several hours and after recovery of the animals, the values approached to the normal level. The experiments proved that O_2 overpressure is not only enhancing the radiation effect but also certain metabolic processes and stress effects. This must be considered in the case of radiation therapy under O_2 overpressure. (GE)

24814 INFLUENCE OF MOUSE GENOTYPE ON THE NUMBER OF STEM HEMATOPOIETIC CELLS. I. Number of Endogenous Hematopoietic Spleen Colonies in Mice of Different Strains and in F_1 Hybrids. Kozlov, V. A.; Kolesnikova, S. M.; Grutenko, E. V.; Seslavina, L. S. (Inst. of Clinical and Experimental Medicine, Novosibirsk, USSR). Genetika; 9: No. 6, 51-55(Jun 1973). (In Russian).

The number of endogenous hematopoietic colonies in the spleen of mice of different genotypes irradiated once at the dose of 650 R or twice at the dose of 300 and 650 R was studied. The maximal number of colonies after a single irradiation was found in CC57BR mice, the minimal, which was 25 times less, in BALB/c mice. Preliminary irradiation of animals at the dose of 300 R did not result in any increase in the number of colonies in mice of certain genotypes [BALB/c and (C3H × C57BL)F_1], while in mice of other genotypes (AKR and CBA) a 4-fold increase was observed. (auth)

24815 RATE OF TRANSAMINATION AND DEAMIDIZATION OF GLUTAMINE IN THE SUBCELLULAR FRACTIONS OF THE BRAIN AND LIVER AFTER GAMMA IRRADIATION OF RATS AT 40 R. Tkach, V. M. Vestn. Beloruss. Gos. Univ., Ser. 2; No. 3, 52-55(1972). (In Russian).

Results of determining the activity of transaminase-deamidase of glutamine activated by sodium pyruvate and oxalacetic acid in subcellular fractions obtained from brain and liver homogenates from intact rats and animals exposed to whole-body gamma irradiation at 40 R are presented. The homogenates were prepared 1, 3, 7, 15, and 30 days after irradiation. The changes induced by irradiation included a decrease in the rate of the process under study in the initial periods (days 1 and 3) and multidirectional phasic manifestations in the brain and liver tissues in the later periods. The possible mechanisms of the postradiation changes are discussed. (JPRS)

24816 T CELL DEFICIENCY IN MOUSE ALLOGENEIC RADIATION CHIMERAS. Urso, P.; Gengozian, N. (Oak Ridge Associated Universities, Oak Ridge, TN). J. Immunol.; 111: No. 3, 712-719(Sep 1973).

For obtaining direct evidence of cellular defects in immunologically deficient chimeras, spleen adherent (A) and nonadherent (T and B) cells, were cultured in vitro with sheep erythrocytes and the plaque-forming cell (PFC) response was determined. Chimera A cells cultured with normal host or donor T and B cells produced normal levels of PFC. The response of chimera T and B cells cultured with normal A cells was considerably lower than that of normal host or donor cells. The response of spleen T and B cells from the allogeneic combination (BALB/c × DBA/2)F_1 bone marrow → (C3H × C57BL)F_1 was enhanced by thymus cells from rats, normal hosts, and various mouse strains including parental BABL/c (donor) mice but not by cells from normal donors and parental DBA/2 (donor) mice. Bone marrow cells were also ineffective. In the allogeneic combination (C3H × C57BL)F_1 → (BALB/c × DBA/2)F_1 host thymus again was effective but not donor thymus. Thymus cells from chimeras did not improve the response of either allogeneic combination. Chimera T and B cells cultured with normal host or donor T and B cells severely inhibited the response of host cells but only slightly affected donor cells. Thus, the T cell population is defective in allogeneic chimeras while A cells behave normally and B cells are present and functional in the spleen. Improvement of the response by genetically incompatible (to donor-type chimera cells) thymus cells suggests an allogeneic effect which may be enhanced by the sensitivity of chimera cells to host antigens. The contrasting influences of host, donor, and parental (donor) thymus cells in reconstitution of immune competence indicates that nonspecific and specific factors are operating in inducing immunologic deficiency in chimeras. (auth)

24817 EFFECTS OF SUBLETHAL IRRADIATION ON THE PLAQUE-FORMING CELL RESPONSE IN MICE. Schmidtke, J. R.; Dixon, F. J. (Scripps Clinic and Research Foundation, La Jolla, CA). AT(04-3)-410. J. Immunol.; 111: No. 3, 691-697(Sep 1973).

X radiation (440 R) administered 4 days after a primary injection of 1×10^8 sheet red blood cells (SRBC) into normal BALB/c mice resulted in increased numbers of indirect plaque-forming cells per million spleen cells (PFC/10^6) 3 days after a secondary challenge of 1×10^8 SRBC. The results were compared to control, non-x-rayed mice. The time of x-ray in relation to SRBC injection was critical as x-ray 3, 5, or 6 days after primary SRBC injection did not increase the number of PFC/10^6 cells. The state of increased responsiveness induced by x radiation was dependent on the dose of SRBC used for primary injection and could not be transferred by spleen cells to syngeneic recipient mice. The number of primary direct PFC/10^6 cells was increased when the response was measured 8 days after injection of SRBC and mice x-rayed 48 hr after antigen injection when compared to control non-x-rayed mice; this increase was probably due to a delay in the response induced by x radiation. (auth)

24818 REGULATION OF HOMOCYTOTROPIC ANTIBODY FORMATION IN THE RAT. VII. An Antigen-Specific T Cell Factor That Regulated Anti-Hapten Homocytotropic Antibody Response. Tada, T.; Okumura, K.; Taniguchi, M. (Chiba Univ., Japan). J. Immunol.; 111: No. 3, 952-961(Sep 1973).

An antigen-specific subcellular component, possibly from thymus derived (T) cells that regulate homocytotropic antibody (HTA) formation against dinitrophenylated Ascaris suum extract (DNP-As), was extracted from mechanically disrupted thymocytes and spleen cells of rats hyperimmunized with the homologous antigen. This cell free extract, when injected into HTA-producing animals that had been 400 R x-irradiated and immunized with DNP-As and Bordetella pertusis vaccine so as to produce high and persistant HTA formation, exerted a strong inhibitory effect on the ongoing HTA production of the recipients. A similar thymocyte extract obtained from rats hyperimmunized with the carrier (Ascaris extract, As) alone also showed the inhibitory activity, whereas that from rats hyperimmunized with the hapten coupled to a different carrier (DNP-bovine serum albumin) or with Freund's complete adjuvant alone did not. The inhibitory activity of the thymocyte extract was completely abolished by absorption with immunoadsorbents composed of DNP-As or As, but not with that of DNP-BSA, indicating that the active component has an affinity to carrier molecules. However, the inhibitory activity was not absorbed with antisera directed to rat Fab, μ chain and polyvalent immunoglobulins, suggesting that the active component is not likely to be an immunoglobulin. The activity was significantly reduced by absorption with an immunoadsorbent composed of anti-rat thymocyte serum. These results suggest that the inhibitory cell interaction in the rat HTA formation, previously reported, is mediated by this subcellular component of primed T cell, which is not immunoglobulin in nature but has an affinity and specificity to the carrier molecule. (auth)

24819 REVERSIBILITY OF THE IMMUNODEPRESSION DUE TO EHRLICH ASCITES CARCINOMA. Mocarelli, P.; Villa, M. L.; Garotta, G.; Porta, C.; Bigi, G.; Clerici, E. (Univ., Milan). J. Immunol.; 111: No. 3, 973-975(Sep 1973).

Recipient mice were exposed to 850 R x radiation and Ehrlich ascites carcinoma cells were injected intraperitoneally into prospective donors of thymus, bone marrow, and spleen cells. Some of the prospective recipients were thymectomized. Thymus- and marrow-derived lymphocytes and spleen cells from tumor-bearing and normal donors, transferred to irradiated mice, produced the same numbers of plaque-forming cells to sheep erythrocytes. (HLW)

24820 SEQUENTIAL PATHOPHYSIOLOGIC EFFECTS OF IONIZING RADIATION ON THE BEAGLE THYROID GLAND. Lu, S. T.; Michaelson, S. M.; Quinlan, W. J. (Univ. of Rochester, NY). J. Nat. Cancer Inst.; 51: No. 2, 419-433(Aug 1973). (UR-3490-183).

Response of the thyroid gland to ionizing radiation exposure manifested itself over time: functionally by transient increased activity and progressive hypothyroidism and pathologically by degeneration, hyperplasia, and carcinogenesis. Although such phe-

nomena were described in animals and man, the pathogenesis and mechanism of the reaction have not been elucidated. Dogs were studied to obtain evidence of some factors that may initiate and amplify the visible and functional thyroid derangement. Increase in circulating TSH seemed secondary to the glandular damage. Thyroid-stimulating hormone also seemed to promote the progressive change, its self-perpetuation, and the sequence of events leading to permanent hyperplasia or carcinogenesis. The postirradiation latency for induction of thyroid neoplasia in dog (4–10 yr), man (9–14 yr), and rat (1–2 yr) showed a linear relationship with basal metabolic rate. Although this relationship might have been fortuitous, it could have indicated a fundamental connection with tissue metabolism and thyroid cell turnover rate. (auth)

24821 BIOCHEMICAL DIAGNOSIS OF ACUTE RADIATION SICKNESS IN PIGS. Zicha, B.; Lehky, F.; Otoupal, P.; Hrusovsky, J. (Military Veterinary Research Inst., Prague). Vet. Med. (Prague); 18: No. 4, 251-258(Apr 1973). (In Czech).

A biochemical indicator of postirradiation damage was developed; the indicator is capable of capturing increased separation of the metabolites of nucleic acids in the urine of whole-body-irradiated rats in the first 6 to 12 hours after exposure. The test is based on the determination of deoxycytidine compounds through a thiobarbituric-acid test after preceding isolation of the metabolic by ionex chromatography. The trial revealed significant excretion of deoxycytidine substances proportionate to the radiation dose, allowing for classifying the cases as light, medium, and severe forms of irradiation disease. (auth)

24822 PROBLEMS OF SOME ENZYMATIC SYSTEMS OF DNA BIOSYNTHESIS IN AN IRRADIATED ORGANISM. Benes, J.; Zicha, B. (Military Veterinary Research Inst., Prague). Vet. Med. (Prague); 18: No. 4, 241-249(Apr 1973). (In Czech).

A model of a regenerating, relatively radiosensitive liver tissue of rats was used to study the activity of thymidine (TdR) and deoxyuridine (UdR) kinases in the course of the generation cycle of the liver cell under the conditions of a whole-body exposure to a supralethal dose of 1400 R. The radiation dose used to which the rats were exposed immediately before partial hepatectomy (HE), blocked the increased phosphorylation ability and increased levels of the two kinases, as observed between the 24th and 72nd hours of the generation cycle of unirradiated liver. Like TdR kinase, the level of UdR kinase is at minimum value in a normal liver tissue, as distinct from mitotically active tissues of the small-intestine or spleen type. (auth)

24823 EFFECT OF IONIZING RADIATION ON SOME REGULATORY MECHANISMS OF THE CELLULAR REGENERATION PROCESSES. Lehky, F.; Zicha, B. (Military Veterinary Research Inst., Prague). Vet. Med. (Prague); 18: No. 4, 229-240 (Apr 1973). (In Czech).

Morphological and biochemical changes of the nuclear material of synchronized radiosensitive cells of the liver of rats exposed to whole-body x-irradiation were studied. Information was obtained concerning the effect of ionizing radiation on the size of nuclei, changes of nuclear index and coefficient, reciprocal relation between the DNA and TBA levels of positive substances in the course of the antioxidation capacity of the liver cell and the total RNA level. The changes in the cellular structures can be considered as reflecting disorders in the nucleolar apparatus acting as an important regulatory site for the proliferating properties of the cell. (auth)

24824 EFFECTS OF LIVER PROTECTING AGENTS ON BONE MARROW AND LIVER FUNCTION IN RADIATION-INDUCED LIVER INJURY. Shimura, H. (Showa Univ., Tokyo). Showa Igakkai Zasshi; 32: No. 5, 258-264(May 1972). (In Japanese).

Bone marrow DNA biosynthesis was examined after administration of 2-mercaptopropionyl-glycine (MPG), which is expected to protect the liver from radiation damage, given prior to liver irradiation. After 10 μCi of ^{125}IUdR was administered to mice intraperitoneally, following oral administration of CCl_4 in the dose of 0.005ml/20g, the number of cells in the extracted bone marrow were counted using a Thoma hemocytometer. The uptake of ^{125}IUdR in the bone marrow cells decreased markedly 6 hr after CCl_4 administration with overshoot in 2 days and gradually returned to the normal level after 3 days, while the uptake increased up to 1 day and returned to the normal level after 2 days in mice injected intraperitoneally with 0.5 mg/20g of MPG 30 min prior to CCl_4 administration. In the group administered MPG using x-irradiated rabbits, no decrease of blood clearance was observed. DNA biosynthesis in the extracted bone marrow cells decreased markedly in 6 hrs with overshoot in 2 days and returned to the normal value in 3 days after irradiation in the control mice irradiated with 1000 R of x radiation and injected with 10 μCi of ^{125}IUdR, while no decrease of DNA biosynthesis was observed in the mice administered MPG. The same experiment was performed with glutathione (GSH) as a liver protective agent and GSH was considered to inhibit liver damage induced by irradiation in particular in the cell level damage. (JA)

24825 MUTAGENICITY TESTING OF IRRADIATED FOODSTUFFS USING THE DOMINANT LETHAL TEST. Renner, H. W. (Institut fuer Strahlentechnologie; Karlsruhe; Ger.); Gruenwald, T.; Ehrensberg-Kieckebusch, W. Humangenetik; 18: No. 2, 155-164 (1973). (In German).

The possible mutagenic effect of an irradiated diet was studied using 716 rats (5 generations) and 750 mice (1 generation). The diet consisted of 35% whole milk powder, irradiated with a dose of 4.5 Mrad, and 65% of standard rat diet. In the experiment with mice, an additional group received the same diet, but all of it was irradiated. In the rat tests, the consumption of the irradiated diet did not cause any differences in fertility, duration of pregnancy, litter size, weaning index, sex ratio, or number of fetal malformations. The fertility of male and female mice was also found to be unaffected. Data from five variables of the dominant lethal test on rats and mice were subjected to statistical evaluation and no embryotoxic or mutagenic effects were found. The high content of free radicals in the irradiated food did not give rise to harmful effects in any of the parameters studied. (auth)

24826 RADIATION CARCINOGENESIS. Ilbery, P. L. T.; Rickinson, A. B. (Univ. of Sydney). Australas. Radiol.; 17: No. 1, 66-77(Mar 1973).

A survey is made of aspects of human radiation carcinogenesis with examples of correlations between cancer and radiation exposure, specifically radiation-induced leukemia. Three areas of experimental study using mice are considered, relating the leukemogenic potential of radiation to its actions as an inducer of somatic mutation, as a suppressor of immunological response, and as an inhibitor of cell proliferation. Three sectors of dose-response relationship are characterized. Cells with chromosomal abnormalities appear within the thymus at an early stage of leukemia development. Subsequent chromosomal aberrations may result from these initial sub-microscopic lesions. In the next region the leukemogenesis probability is enhanced as the immune defenses are progressively weakened by higher doses. The third compartment of response is seen at even higher doses where the proliferative capacity and ultimate survival of the mutant cells is progressively reduced by excessive radiation damage. (auth)

24827 EFFECTS OF TOTAL EXPOSURE TO IONIZING RADIATIONS ON THE PLASMATIC TRYPTOPHAN LEVELS AND THE HEPATIC TRYPTOPHAN PYRROLASE ACTIVITY IN RATS. Morelis, P.; Grafmeyer, D.; Riotte, M.; Philibert, H. (Centre de Recherches du Service de Sante des Armees, Lyon). Compt. Rend. Soc. Biol.; 166: No. 8, 1000-1004(1972). (In French).

Male wistar rats of approximately 200 g were exposed to 50 rads of ^{137}Cs radiation per minute during 19 minutes. The enzymatic activity of the hepatic tryptophan pyrrolase increased by 30% after the fourth hour and attained a value 2.5 times greater than that of the standard specimens after a period of 4 days. The plasmatic tryptophan levels were measured 4 days after irradiation. A reduction in the total amount of tryptophan was observed, the Wilcoxon test showing this reduction to be highly significant. In contrast, the free tryptophan level is higher in the irradiated specimens than in the nonirradiated specimens. (auth)

24828 EFFECT OF X-RAY IRRADIATION ON HISTONE BIOSYNTHESIS OF SARCOMA 180 ASCITES TUMOR CELLS. Lee, K. B.; Lee, H. S. Korean Biochem. J.; 5: No. 2, 69-83 (1972).

The effect of x irradiation on histone biosynthesis of Sarcoma 180 ascites tumor cells was studied. The tumor-bearing mice were irradiated with a dose of 1250 R prior to 24 hrs double-labeling with 10 μCi of glycine-1-^{14}C and 20 μCi of ^{32}P-orthophosphate. Sham irradiated mice were used as control. The time course changes in the incorporations of labeled compounds into histone and DNA have been followed. Contents of histone fractions from Sarcoma 180 ascites tumor cells markedly differed from normal tissues, i.e., mouse liver, rat and calf thymus. X irradiation hindered ^{14}C-glycine incorporation into histone by 14%. Uptake of ^{14}C was highest into f3 and was lowest into f2b among histone fractions both in normal and irradiated mice. The incorporation of ^{14}C-glycine into histone reached a maximum 4 hrs after glycine administration. Radioactivity of ^{14}C-glycine was less distributed about 12% in glycine fraction of histone hydrolysates from x irradiated animal. A decreased ^{32}P-incorporation (about 14%) into DNA was observed in irradiated mice. Relationships between histone biosynthesis and DNA metabolism are also discussed. (Korean Sci. Abstr.)

24829 EFFECT OF WHOLE-BODY X IRRADIATION ON PLASMA PROTEIN SYNTHESIS: ROLE OF ADRENALS. Nadkarni, G. S. D.; Samuel, A. M. (Bhabha Atomic Research Centre, Bombay). Int. J. Radiat. Biol.; 23: No. 5, 469-476(May 1973).

In rats exposed to whole-body x irradiation (800 R), the changes

in plasma concentrations and glycine-1-^{14}C incorporation into albumin, fibrinogen, and total plasma proteins were followed for 6 days. In intact rats the relative synthesis rate of fibrinogen showed two peaks at 3 hrs and 4 days after irradiation (166 and 654% of controls). In adrenalectomized and irradiated rats this biphasic response was abolished, and only a plateau was observed between 3 hrs and 4 days. Adrenalectomized rats also showed a sharp rise in albumin synthesis 3 hrs after irradiation. Thereafter, though it decreased progressively, the albumin synthesis rate was more than that of adrenalectomized-unirradiated rats. The first peak (at 3 hrs) of albumin and fibrinogen synthesis in adrenalectomized rats appeared to be due to factors other than corticosteroids. Further, it appeared that corticosteroids may not be the prime factors responsible for the elevated plasma protein synthesis in intact rats after irradiation. It is suggested that, since the magnitude of increase was more in intact than in adrenalectomized rats, these hormones seem to play a contributory role in plasma-protein anabolism. (auth)

24830 TREATMENT OF THE EXPERIMENTAL HAEMORRHAGIC RADIATION SYNDROME OF THE RAT WITH CEREBRAL PHOSPHOLIPIDS AND AN ANTIFIBRINOLYTIC (AMCHA). Spreafico, P. L.; Galetti, G.; Cuttin, S. (Univ., Pavia, Italy). Arzneim.-Forsch.; 23: No. 3, 441-444(1973). (In German).

In comparative experiments, non-irradiated and x-irradiated rats, the latter having a substantially protracted bleeding time after resection of tail end piece and an increased bleeding intensity, were treated either with cerebral phospholipids (Tachostyptan), an antifibrinolytic (aminomethylcyclohexane-carbonic acid; AMCHA) or a combination of both active substances (Amcastyptan). Compared with irradiated untreated rats, a reduction in bleeding time and bleeding intensity was observed in the irradiated rats treated with Amcastyptan while or after being irradiated. The same effect, to a lesser degree but likewise clearly, was displayed after the administration of Tachostyptan alone. This effect, however, was less evident after administration of an appropriate dose of AMCHA alone. The administration of Amcastyptan, Tachostyptan, and AMCHA to normal non-irradiated rats likewise brought about a reduction in bleeding time and in bleeding intensity. These findings were most evident in the case of Amcastyptan. (auth)

24831 HISTOLOGICAL CHANGES IN GUINEA PIG LUNGS AFTER INHALATION OF FORMALDEHYDE AND RADIATION AND THE INFLUENCE OF DEXAMETHASONE-21-ISONICOTINATE ON THEM. Otte, W.; Kroepelin, K. (Univ., Freiburg i. B.). Arzneim.-Forsch.; 23: No. 3, 420-424(1973). (In German).

The semiquantitative analysis of histological findings in the bronchopulmonary system of the guinea pig after inhalation of formaldehyde showed a positive effect of treatment by dexamethasone-21-isonicotinate on the peribronchial cell infiltration in the beginning and in the advanced stage of this pathological reaction. The development of interstitial edema also appeared to be influenced positively. The injuries of rat lungs by 3,000 R showed, after prophylactic application of dexamethasone-21-isonicotinate, significantly less perivasal enlargement of lymphatic system and less interstitial edema during the first 24 hr after the insult. Later damages caused by reactions to radiation showed no improvement by treatment. (auth)

24832 SOME LOCAL EFFECTS OF ^{60}Co GAMMA RADIATION ON THE EQUINE CARPUS. 1. Effects on Dermal Blood Flow and Cutaneous Temperature. Dixon, R. T. (Univ. of Sydney); Gillette, E. L.; Carlson, W. D. Aust. Vet. J.; 49: No. 3, 130-134(Mar 1973).

An evaluation of short term effects of γ rays on bones of horses was made. Irradiation of the carpus produced relatively marked changes in dermal blood flow rates. These charges were considered due to an initial hyperaemia and a subsequent inflammatory reaction. The reaction produced by 1000 R was not twice as great as that produced by 500 R but it lasted longer. Exposure doses of 2000 R to the periosteum were masked by the onset of an interference with capillary blood flow rather than an acceleration Changes in cutaneous temperature (of about 1°C elevation) estimated using a thermistor and telethermometer, accompanied or preceded charges in RT_{50}. These returned to normal in 3 to 7d. Most reactions had subsided by 35 to 42d post-irradiation but all groups showed signs of recurrences of increased blood flow at 8 weeks. (AT)

24833 SOME LOCAL EFFECTS OF ^{60}Co GAMMA RADIATION ON THE EQUINE CARPUS. 2. Observed Clinical Effects and Changes in Estimated Values of Bone Mineral Content. Dixon, R. T. (Univ. of Sydney); Gillette, E. L.; Carlson, W. D. Aust. Vet. J.; 49: No. 3, 135-138(Mar 1973).

Exposure doses of 500, 1000, and 2000 R were made to the periosteum of each horse. Radiographic determinations of bone density charges were made using a densitometer. The densities were converted to mg/cm^2 bone mineral by comparison with an Al step-wedge standard, and most showed immediate density decrease that did not return permanently to normal for up to 2 months. Except in one 2000 R case there was no evidence of demineralization to the extent that pathological fractures occurred. Changes in hair pigmentation were seen in all groups. The 2000 R group showed epilation and dry desquamation. (AT)

24834 BIOCHEMICAL BASES OF AMINO ACIDURIA RESULTING FROM WHOLE-BODY IRRADIATION. Tibor, B. Honvedorvos; 25: No. 1, 64-73(1973). (In Hungarian).

The literature (73 references, largely English language) on radiation-induced amino aciduria is reviewed. (TTT)

24835 PROBLEMS OF EARLY HEMATOLOGICAL INDICATION OF RADIATION INJURIES IN CASE OF COMBINATION WITH MECHANICAL TRAUMA. Vallo, J.; Novak, J.; Ver, P., Honvedorvos; 24: No. 4, 252-256(1973). (In Hungarian).

The influence of mechanical traumas on the number and distribution of white blood cells was studied in order to determine whether the traumas may cover up the effect of radiation injury. The work involved determination of the lymphocyte number in human victims of industrial and traffic accidents; in addition, experiments were carried out on rabbits subjected to bleeding, 400 R of x radiation, and to application of a tourniquet in various combinations. It was concluded that the absolute lymphocyte number does not yield a reliable indication for early diagnosis of radiation injury if combined with mechanical trauma. (TTT)

24836 EVIDENCE FOR A DOSE-RATE EFFECT IN TYPE B SPERMATOGONIA OF THE MOUSE AT HIGH DOSE-RATES. Chadwick, K. H.; Leenhouts, H. P. (Instituut voor Toepassing van Atoomenergie inde Landbouw, Wageningen, Netherlands). Int. J. Radiat. Biol.; 23: No. 6, 627-629(Jun 1973).

A brief reanalysis of the results given by Bianchi, M., et al., (Int. J. Radiat. Biol., 22, 191) was made for the survival of type B spermatogonia in the mouse after irradiation with 250 kVp x rays at 0.7 rad/sec, and electrons at 2×10^7 rad/sec and 2×10^8 rad/sec, using the molecular theory of cell survival (Chadwick, K. and Leenhouts, H. P., Phys. Med. Biol., 18, 78). It is suggested that this analysis of the electron results still gives a positive effect and implies the existence of a time-dependent repair mechanism operating in these cells, with a time-constant in the order of micro-seconds. (UK)

24837 MEASUREMENTS OF TUMOR-CELL RADIOSENSITIVITY IN VIVO USING LUNG MACROCOLONY ASSAY: DOSE-SURVIVAL ARTEFACT DUE TO TAIL TRAPPING. van den Brenk, H. A. S. (Saint Thomas Hospital, London). Int. J. Radiat. Biol.; 23: No. 6, 631-635(Jun 1973).

A proportion of ascites tumor cells injected intravenously into a small tail vein of a rat could be diverted into venous complexes connected to the injected vein and be trapped for at least 4 hrs before the cells became mobilized by restoration of circulatory activity in the region and were carried by the circulation to the lungs. This phenomenon of tail trapping could affect the shape of x radiation dose-survival curves obtained in vivo when the lungs were locally irradiated after intravenous inoculation. Lung colonies were compared in rats that were given 1500 rads local thoracic radiation 4 hrs after the injection of tumor cells, with those in rats given 1500 rads to the thorax plus 750 rads to the tail. In a further dose-response experiment to determine cell survival over a range of 0 to 2000 rads to the lungs, the numbers of injected tumor cells were increased with increase in dose namely 2×10^2 (50 to 300 rads), 2×10^3 (500 to 1000 rads), and 2×10^4 (1250 to 1750 rads) cells respectively. Tail-trapping of cells did not appear to be affected by coagulation of the blood heparinization of recipients not significantly affecting the lung-colony count. (UK)

24838 PHYSIOLOGICAL STUDIES ON THE BLOOD OF ANAEMIC CATTLE: EFFICACY OF BOVINE ERYTHROPOIETIN(S) IN IRRADIATED MICE. Reddi, O. S.; Naidu, N. V.; Rao, M. S. (Osmania Univ., Hyderabad, India). Indian J. Anim. Sci.; 42: No. 10, 789-797(Oct 1972).

Experiments on the evaluation of erythropoietin(s) in radiation injury showed that the factor(s) have both protective and restorative action on the bone-marrow depression induced by lethal doses of ionizing radiations. Treatment with erythropoietin prior to and after exposure to a single whole-body dose of 1,000 R x rays has caused an earlier regeneration of erythropoiesis and increased survival in mice. It is also found that the erythropoietin(s) both in the anemic and non-anemic fractions significantly reduced the frequency of dominant lethals in mice exposed to 700 R x rays. (auth)

24839 INTERVAL BETWEEN LETHAL IRRADIATION AND INJECTION OF BONE MARROW CELLS. Rogan, J.; Silobrcic, V. (Inst. of Immunology, Zagreb). Period. Biol.; 74: No. 2, 49-52 (Jul 1972).

CBA mice were irradiated with 950 R whole-body x irradiation.

Seventy-two mice, subdivided into nine groups of eight mice each, received allogeneic (C57BL) bone marrow cells: 5×10^6 cells were injected either on the day of irradiation (day 0) or 1, 2, 3, 4, 5, 6, 7, or 8 days afterwards. A further group of 78 CBA mice received syngeneic bone marrow; the number of cells and the interval between irradiation and the injection were the same as for the allogeneic bone marrow. Allogeneic marrow saved all the recipients from acute radiation death when injected within the first 48 hrs after irradiation. If given on later days, it progressively saved fewer mice, so that among animals receiving the marrow on the 8th day none had lived more than 20 days. Syngeneic marrow was more effective; it prevented early death of all animals injected during the first 5 days after lethal irradiation. Its effectiveness declined with time, but syngeneic marrow remained more efficient than allogeneic marrow. No correlation was found between the time of injection of the allogeneic marrow and the mortality due to secondary disease in CBA recipients. (auth)

24840 ACUTE RADIODERMATITIS IN THE BEAGLE DOG: GROSS OBSERVATIONS AFTER SINGLE-DOSE EXPOSURE WITH X IRRADIATION. Park, R. D. (Univ. of Illinois, Urbana); O'Brien, T. R.; Baker, B. B.; Morgan, J. P. Amer. Vet. Radiol. Soc.; 14: No. 1, 49-56(1973).

Five different single doses of 610, 1220, 1830, 2440, and 3660 rads were administered to the skin of each of four dogs. These doses were delivered as a single treatment using 200 kVp, 15 mA exposure beam (half-value layer = 5 mm Al) with an FDS of 50 cm and a backscatter factor of 1.3. Forty-eight cm^2 areas were treated over the back and neck of the animals. The development and repair of acute radiodermatitis were observed during a 50 day period after irradiation. The most severe acute reaction produced by doses of 610 rads was erythema. Twelve-hundred and twenty rads caused dry desquamation. Eighteen-hundred and thirty rads resulted in moist desquamation and both 2440 and 3660 rads caused acute ulceration and necrosis. Ulcers produced by 3660 rads were larger and did not heal as fast as those produced by 2440 rads. A time sequence of developing radiodermatitis after a single-dose irradiation was also established. The acute effects of radiation on skin are proportional to the dose. Dose-effects reported here more closely simulate those reported for man than some previously reported for the dog. (auth)

24841 INFLUENCE OF GENOTYPE AND NEONATAL IRRADIATION UPON OPEN-FIELD LOCOMOTION AND ELIMINATION IN MICE. Nash, D. J. (Colorado State Univ., Fort Collins). J. Comp. Physiol. Psychol.; 83: No. 3, 458-464(1973).

A diallel genetic analysis was used in a study of postnatal behavior of mice exposed to neonatal irradiation. Five levels of exposure were used: 0, 50, 100, 200, or 300 roentgens. Locomotion and elimination in the open field were tested at 49 days of age. Decreases in body weight and locomotion were observed. Heterosis was evident in locomotion and elimination, hybrids being more active (18%) and eliminating more (39%) than inbreds. Other genetic influences on behavior were noted in the significant differences among inbreds, in general, combining ability and maternal effects. Results demonstrate that the genetic mechanisms underlying control of locomotion and elimination in the open field are complex and that specific interactions may exist among the sexes and genotypes in non-irradiated, as well as irradiated, animals. (auth)

24842 HASSALL'S CORPUSCLES OF THE GUINEA-PIG THYMUS AFTER ^{60}Co LOCAL-IRRADIATION. Sugiyama, S. (Nara Medical Univ., Kashihara, Japan). Nara Igaku Zasshi; 23: No. 5-6, 421-443 (Dec 1972). (In Japanese).

The cervical region of the guinea pig was locally irradiated by ^{60}Co 500 R or 800 R. Guinea pigs were killed at timed intervals from about one hour to thirty-five days after the beginning of the experiment. The thymus sections were stained with Mayer's hematoxylin-eosin and Scott's aldehyde-fuchsin technique. In their microscopical examinations, some Hassall's corpuscles were stained deep purple and the others were not stained with Scott's aldehyde-fuchsin technique. The former were called "AF(+) corpuscles" and the latter "AF(-) corpuscles". The ratio (%) of the number of AF(+) corpuscles to the total number of corpuscles seen in whole microscopical field was called the AF(+) ratio. In this experiment, AF(+) ratio was calculated and the sizes of Hassall's corpuscles were measured in order of size. In the normal guinea pig, there was no significant difference in the thymus weight, AF(+) ratio and size of Hassall's corpuscles between the left and right thymus of the individual. Each thymus weighed more than 150 mg. AF(+) ratio was calculated at about 50%. Hassall's corpuscles measured about 50μ in size. In the locally irradiated guinea pig, the thymus about seven days after irradiation involuted severely. This involuted thymus decreased in weight. Its AF(+) ratio was higher, and its Hassall's corpuscles were bigger in size. The thymus thirty-five days after irradiation increased in weight. Its AF(+) ratio and its sizes of Hassall's corpuscles became normal. Guinea-pig thymus began to involute with the lapse of days after irradiation and its involution became severe about seven days after irradiation; after that it began to recover from the effects of irradiation. (auth)

24843 CYTOGENETIC RADIOSENSITIVITY AND CHIASMA FREQUENCY IN WILD AND LABORATORY MICE. Berry, R. J. (Royal Free Hospital, London); Beechey, C. V.; Searle, A. G. Mutat. Res.; 19: No. 1, 129-131(Jul 1973).

Wild mice from the mainland of Britain and laboratory mice were exposed to 300 R x radiation and were killed 12 to 13 weeks later. Spermatocytes were examined for multivalent configurations and the tabulated results show similar translocation frequencies in wild and laboratory mice. Results of previous studies indicated a higher frequency of chiasmata in laboratory mice and an experiment is described to determine the mode of inheritance of this difference. (HLW)

Invertebrates

Refer also to abstracts 24501 and 24698.

24844 (AEC-tr-7444, pp 63-68) VIABILITY OF THE PROGENY OF IRRADIATED CELLS (EXPERIMENTS ON PARAMECIUM CAUDATUM AND AMOEBA PROTEUS). Bychkovskaya, I. B.; Ochinskaya, G. K. (Central Scientific Research Roentgeno-Radiological Inst., Leningrad). Translated from Radiobiologiya; 13: No. 2, 211-215(1973).

It was shown by the method of individual culturing that after irradiation of infusoria and amoebas with x rays at doses of 0.5 to 40 kR, a certain constant level of death, which does not depend (within a given interval) on the value of the dose, is established in the progeny of these cells for an unlimited period of time. The detected hereditary lethal effect differs qualitatively from the known types of postradiation death of cells, in particular, those described for the same objects under the influence of large doses of radiation. (tr-auth)

24845 (AEC-tr-7444, pp 125-130) INVESTIGATION OF THE RADIOBIOLOGICAL RESPONSES IN AMOEBA PROTEUS. Communication 3. DNA Content Influence of Modifying Factors on the Survival of Amoebas After Irradiation. Kharlamova, L. A. (Scientific Research Inst. of Medical Radiology, Obninsk, USSR). Translated from Radiobiologiya; 13: No. 2, 260-264(1973).

A series of investigations was conducted to determine the causes of the different radiosensitivity of resistant and sensitive strains of A. proteus. No differences in the DNA content were detected. Delay of the first postradiation division in the case of starvation did not reveal processes of postradiation recovery in any of the strains. Reducing the dose rate and lowering the temperature during the periods of irradiation did not influence the effectiveness of the action of radiation. It was concluded that neither the ploidy nor the intensity of recovery processes can explain the observed differences in the radiosensitivity of the strains of amoebas studied. (tr-auth)

24846 (AEC-tr-7444, pp 159-162) CIRCADIAN RHYTHM OF THE RADIOSENSITIVITY OF THE CODLING MOTH LASPEYRESIA POMONELLA L. (LEPIDOPTERA, TORTRICIDAE). Pristavko, V. P.; Sem'yanova, N. E. (Ukrainian Scientific Research Inst., Kiev). Translated from Radiobiologiya; 13: No. 2, 286-289(1973).

The circadian rhythm of the sensitivity of codling moths to x irradiation was studied. It was established that when the moths are irradiated at a sterilizing dose of 4 kR during the period of their greatest daily activity (from 2100 to 0100), the lifetime of the insects is substantially reduced in comparison with irradiation at a different time of day. (tr-auth)

24847 (UCLA-12-919, pp 32-39) ANIMAL ECOLOGY. 1973. In annual progress report for the period ending June 30, 1973.

Effects of gamma radiation on absorption of water vapor from the air by the insect, Arenivaga sp., were studied. The ability to absorb water vapor was progressively reduced at higher doses. Progress is also reported on the following research projects: experimental analyses of the dynamics of vertebrate populations; hormonal induction of color change in leopard lizards; analysis and modeling of a desert ecosystem; electrolyte excretion by the nasal gland of the lizard, Dipsosaurus dorsalis; the role of adrenal corticosteroids in the regulation of kidney function in the desert lizard; water and electrolyte budgets of a free-living desert lizard, Sauromalus obesus; behavior, diet, and reproduction in a desert lizard; temperature regulation by the inflorescence of Philodendron; daily activity of desert arthropods in relation to climate; behavior of desert cockroaches; trophic relationships of arthropods; and distribution of soil arthropods. (HLW)

24848 CAUSE OF LIFE SHORTENING IN ADULT FLESH FLY, SARCOPHAGA PEREGRINA. Sakka, M. (Tohoku Univ., Sendai). Nippon Igaku Hoshasen Gakkai Zasshi; 33: No. 2, 130-133(Feb 1973). (In Japanese).

Male adult flesh flies, Sarcophaga peregrina, were irradiated with a single exposure of 8, 16, 24, 40, 80, 120, and 160 kR of x rays on the first day of imago formation and survival curves were plotted on semilog paper. Survivors decreased exponentially with a half-life of 1.2 days after 80 kR or more. Death is attributed to large dose effects. In the control population without irradiation, survivors decreased slowly in aging phase until the population size reached 50% of the original size but decreased exponentially thereafter with a half-life of 7 days. In the region from 100 to 50% of survival, insects aged naturally in aging phase and then died naturally in dying phase. In the dose range from 8 to 40 kR, survival curves were composed of three components: aging phase, dying phase, and large dose effect. Dying phase remained constant up to 40 kR. Aging phase decreased linearly while large dose effects increased with dose. Chronic treatment with ethyl alcohol shifted the survival curves in both sexes. Aging phase decreased and half-life of natural death decreased. After a single irradiation, the half-life of natural death and of large dose effects remained unchanged in spite of the shift of survival curves but chronic alcohol treatment changed the slope of the curves. (auth)

24849 EFFECT OF RADIOPROTECTION EFFECTED AT DIFFERENT STAGES IN THE DEVELOPMENT OF DROSOPHILAS MELANOGASTER ON THEIR LIFE TIMES. Giess, M. C.; Planel, H. (Univ., Toulouse). Compt. Rend., Ser. D; 276: No. 6, 1029-1032(5 Feb 1973). (In French).

It has already been shown that Drosophiles protected against natural ionizing radiations throughout their entire lives have on the average shorter lives than those living in a normal environment. Using these data, an attempt was made to determine whether these radiations act throughout the lifetime of this organism or only during certain periods. (FR)

24850 X-RAY-INDUCED MUTATION SPECTRA OF DIFFERENT GERM-CELL STAGES OF DROSOPHILA MALES WITH A DOUBLE MARKED Y-CHROMOSOME AND EITHER A NORMAL X- OR A RING-X- CHROMOSOME. Suter, K. E. (Univ., Zurich). Mutat. Res.; 19: No. 1, 83-98(Jul 1973). (In German).

Different germ-cell stages of Drosophila males with a double marked Y-chromosome and either a normal X- or a ring-X chromosome were irradiated with x rays, inducing the following aberrations: chromosome loss, chromosome gain (XYX-females), partial Y loss, and isochromosomes of the Y-chromosome. Doses of 520 rad in spermatocytes and spermatids and 2600 rad in sperm, produced the same effect in these stages with regard to the chromosome loss in the males with a normal X, and the following results were obtained: The partial Y loss in postmeiotic stages is small in comparison with spermatocytes in both stocks. This could mean that in spermatocytes this aberration is determined by exchange processes, which can only be induced and/or detected in premeiotic stages. In spermatocytes and mature sperm of males with a ring-X chromosome, the chromosome loss was 2.9 times greater than in those with a normal X. In spermatids of the males with a ring-X the rate of loss was only 1.5 times greater. In spermatocytes of either males with a ring-X or a normal X a similar high rate of isochromosomes could be induced. However, in spermatids and mature sperm the rate of induction of isochromosomes was found to be very small. These results seem to indicate that in mature sperm the rejoining of breaks in the Y-chromosome takes place before, and in the X-chromosome usually after the replication. If in post-meiotic stages of Drosophila the X- and Y-chromosomes existed as chromatid-like subunits then in spermatids these should behave as a structural unit. In sperm similar frequencies of individuals could be induced with a single isochromosome type in all body cells as of individuals with two types of isochromosomes (isochromosome mosaics). This result seems to indicate that after irradiation of sperm one of the first two division nuclei is lethal in a proportion of the zygotes. (auth)

Radionuclide Effects (Internal Source)

Man

Refer also to abstracts 24460, 24461, 24473–24476, 24763, and 24862.

24851 (AAEC/E-272, pp II.1-II.5, Paper II) PHILOSOPHY OF ENVIRONMENTAL PROTECTION AND CONTROL. Watson, G. M. Apr 1973.

From AAEC symposium on environmental and radiological safety aspects of the mining and processing of uranium; Lucas Heights, Australia (9 Dec 1971).

Two problems are considered: protection of the environment and the protection of man within that environment. These problems are assessed under four broad headings: the effects of man-made or -released radiation in relation to the natural background; criteria for the allowable release of radioactivity; calculations of allowable releases with respect to the many pathways taken by released radionuclides to cause radiation exposure to man; and several parameters necessary to insure adequate environmental controls. (AT)

24852 (AAEC/E-272, pp VI.1-VI.13, Paper VI) INTRODUCTION TO RADIOLOGICAL SAFETY. Button, J. C. E. Apr 1973.

From AAEC symposium on environmental and radiological safety aspects of the mining and processing of uranium; Lucas Heights, Australia (9 Dec 1971).

Basic definitions are given of the nature and hazards of ionizing radiations, together with explanations of the various units of radiological measurement. The derivation of dose limits and various protective measures are also discussed. (AT)

Animals

Refer also to abstract 24854.

24853 (COO-3382-13, pp 9) RADIOBIOLOGY OF Fe-55 IN MICE. [nd].

Radioactivity studies.

Iron-55 was administered to mice at doses ranging from 0.1 to 10.0 μCi/gm of body weight and the uptake and retention kinetics were measured to study effects on the hematopoietic system and circulating blood cells. Preliminary results indicate a significant increase in the rate of ^{55}Fe turnover from the blood of animals injected with 10 μCi/gm compared to controls given tracer doses of ^{59}Fe. (CH)

Nuclide Kinetics and Toxicology

Refer also to abstract 24362.

Man

Refer also to abstracts 24460, 24482, 24851, 24892, 24908, 24912, and 24919.

24854 (COO-3382-13) RADIOACTIVITY STUDIES. Progress Report. (New York Univ., N. Y. Medical Center). [nd]. 10p. Dep. NTIS $3.00.

The results were grouped in 5 sections and a separate abstract prepared for each section. (MCG)

For abstracts of individual sections see: 24477, 24853, and 24855–24857.

24855 (COO-3382-13, pp 1-4) METABOLISM OF AMERICIUM-241 IN THE ADULT BABOON AND HUMAN MAN AND BOY. [nd].

Radioactivity studies.

Adult baboons were given intravenous injections of ^{241}Am as citrate and the tissue distribution and retention were measured during a 15-month period by whole-body counting and radiometric analysis of samples of blood, feces, urine, and biopsy samples of bone and liver. The results showed rapid clearance from blood and liver and a bone clearance half-time of several years. Administration of 14.3 mg DTPA/kg body weight three times per week over a period of three weeks increased the excretion rate to between three and four percent of the body burden. The retention of ^{241}Am in a boy and his father during a four-year period following accidental uptake is discussed. In addition to whole-body counting, ^{241}Am excretion in urine and feces was measured. (CH)

24856 (COO-3382-13, pp 4-6) LEAD-210 METABOLISM IN URANIUM MINERS AND ADULT BABOONS. [nd].

Radioactivity studies.

The content of ^{210}Pb in skeleton and excretion rates in urine and feces of uranium miners were measured by whole-body counting and radiometric analysis of samples of blood, urine, and feces. Results indicated a retention half-time in bone of between three and eight years. The retention of ^{210}Pb in bones of adult baboons following injection was studied by whole-body counting and measurements of ^{210}Pb–^{210}Po ratios in bone samples obtained at autopsy. (CH)

24857 (COO-3382-13, pp 6-7) IAEA PLUTONIUM INTERLABORATORY CALIBRATION EXPERIMENT. [nd].

Radioactivity studies.

Calibration factors for the in vivo measurement of ^{238}Pu and ^{239}Pu in human lungs as a function of body size were obtained using inhaled ^{51}Cr and ^{103}Pd particles as simulants. Optimum subject-detector geometry for the in vivo measurement of low-energy photon emitters in human lungs was determined. A mathematical model for americium and plutonium distribution in human lungs was developed. The performance of scintillation detectors inside a shielded whole-body counting room was evaluated. (CH)

24858 (UCLA-12-919, pp 58-64) CLINICAL NUCLEAR MEDICINE. 1973.

In annual progress report for the period ending June 30, 1973.

Bronchial mucous transport after lung autotransplantation in dogs was studied using ^{99m}Tc-albumin microaggregates. Results indicated that after transplantation there was impaired mucous transport on the operated side in the early postoperative periods. Progress is also reported on the following research projects: use of inhalation aerosol scan for early detection of chronic obstructive pulmonary disease; comparison of radioaerosol with radioxenon inhalation procedures in obstructive lung disease and pulmonary embolism; correlative studies on metastatic liver disease; evaluation of circulatory resistance in the portal system of the liver with radiocolloids; indium-labeled bleomycin as tumor scanning agent; cardiac surgery in cyanotic children assessed by ^{99m}Tc macroaggregated albumin; detection of premature craniosynostosis with ^{18}F; and streamline flow in the human portal vein. (HLW)

24859 (UCLA-12-919, pp 65) CURRENT AND FUTURE DEVELOPMENTS. 1973.

In annual progress report for the period ending June 30, 1973.

Plans for new research projects in nuclear medicine and radiobiology are discussed. Studies on the following projects are anticipated; diagnosis of pulmonary embolism by perfusion and ventilation scanning; studies on asthma and bronchitis by radionuclide lung imaging and radioaerosol inhalation; and studies on nonspecific immunity in Hodgkin's disease and carcinomas of the prostate and lung. (HLW)

24860 (UCLA-12-919, pp 79-82) CARDIAC STUDIES. 1973.

In annual progress report for the period ending June 30, 1973.

Progress is reported on the following research projects: evaluation of ^{43}K and ^{129}Cs for myocardial imaging; evaluation of ventricular dysfunction by myocardial imaging; uptake and clearance of ^{129}Cs in experimental myocardial infarction; myocardial extraction of fatty acids and carboxylates labeled with ^{131}I, ^{123}I, ^{43}K, ^{99m}Tc, ^{11}C, and ^{18}F; and myocardial turnover characteristics of labeled fatty acid analogs. (HLW)

24861 (UCLA-12-919, pp 91-93) TOTAL BODY COUNTER ACTIVITIES. 1973.

In annual progress report for the period ending June 30, 1973.

The total body counter was used for studies on metabolic turnover rates of immune serum globulins in human and for studies on transport and distribution of ^{51}Cr-labeled lymphocytes administered to patients undergoing thoracic duct lymph drainage. Body burdens of ^{137}Cs in adult residents of Southern California were also determined. Results of monitoring continuously since 1959 suggested that human body contamination is now in a steady state with recycling of the ^{137}Cs back into human food compensating for the decline in fallout, or that the observed activity is buried in body tissues and relatively unavailable for metabolic loss. (HLW)

24862 (UCLA-12-919, pp 110-112) SEMICONDUCTOR DETECTOR PROBES FOR BIOLOGICAL AND MEDICAL APPLICATIONS. 1973.

In annual progress report for the period ending June 30, 1973.

24863 DOSIMETRY OF UNABSORBED BETA EMITTERS IN THE GASTROINTESTINAL TRACT. Unnikrishnan, K.; Hukkoo, R. K.; Somasundaram, S. (Bhabha Atomic Research Centre, Bombay). Health Phys.; 25: No. 2, 141-146(Aug 1973).

A formalism for calculating the depth-dose distributions in different sections of the GI tract due to unabsorbed beta emitters is developed based on a mathematical model and using Berger's absorbed dose distribution (J. Nucl. Med.; 12: Supplement No. 5 (1971)). Computations are carried out for some 66 beta emitters, and the results are analyzed to study the deviations from the 2π irradiation model assumed by the ICRP Committee II arising out of (1) the cylindrical nature of the GI tract and the differences in the spectral shapes of the betas, and (2) the radiation shielding offered by the mucosa lining the intestinal walls. Differences of the first category prove to be not really significant. The reported thickness of the mucosa being 140 to 420 μm, the dose rates at a depth of 100 μm are used to provide a rather conservative estimate of the shielding effect. These dose rates are found to be considerably low for quite a few beta emitters, being actually zero for some. The possible contribution from cross irradiation between adjacent coils of the small intestine was also evaluated. (auth)

24864 ON-LINE SYSTEM FOR ACQUISITION AND PROCESSING OF CEREBRAL BLOOD FLOW DATA. Wyper, D. J.; Rowan, J. O. Comput. Biol. Med.; 3: No. 1, 55-62(Apr 1973).

Regional cerebral blood flow is measured by monitoring the clearance from the brain of the gamma emitting radioisotope ^{133}Xe following an intracarotid artery bolus injection. On-line data analysis, which is performed on a PDP 12/30 digital computer, involves exponential stripping to isolate grey and white matter flows and integration of the clearance curves to infinity to enable the mean flow to be calculated. The data is displayed in real time and stored on the PDP 12 Linc tapes as a permanent record. (auth)

24865 EVALUATION OF LUNG UPTAKE OF COLLOID DURING LIVER IMAGING. Keyes, J. W. Jr.; Wilson, G. A.; Quinonest, J. D. (Univ. of Michigan Medical Center, Ann Arbor). J. Nucl. Med.; 14: No. 9, 687-691(Sep 1973).

A marked increase in lung accumulation of activity was visualized on routine liver scanning in a group of 22 patients selected to eliminate colloid variations, bone marrow uptake, and blood pool activity as contributing factors. The only common findings in the group were the presence of some type of liver disease and a poor prognosis. Clinical and laboratory evidence point to either an alteration in the pattern of RES activity or rapid in vivo clumping and secondary pulmonary microembolization. The present study was inadequate to rule out either of these possibilities. The findings support the concept of significant alterations in the physiology of intravascular colloids in certain severe illnesses and suggest that the liver scan may have a role in the evaluation of such illnesses. (auth)

24866 RADIATION DOSIMETRY OF ^{131}I-19-IODOCHOLESTEROL. Kirschner, A. S.; Ice, R. D.; Beierwaltes, W. H. (Univ. of Michigan, Ann Arbor). J. Nucl. Med.; 14: No. 9, 713-717(Sep 1973).

The only currently available radiopharmaceutical capable of locating the adrenal gland, imaging it, and quantitating its function is ^{131}I-19-iodocholesterol. To evaluate the relative radiation risk versus benefit, the absorbed radiation dose was calculated from pharmacokinetic human and animal data. (auth)

24867 HIGH CONCENTRATION OF ^{99m}Tc-SULFUR COLLOID FOUND DURING ROUTINE LIVER SCAN IN LUNGS OF PATIENT WITH ADVANCED BREAST CANCER. Gillespie, P. J.; Alexander, J. L.; Edelstyn, G. A. (Northern Ireland Radiotherapy Centre, Belfast). J. Nucl. Med.; 14: No. 9, 711-712(Sep 1973).

A case is described in which both lungs were clearly visualized following an injection of 3.0 mCi of ^{99m}Tc-sulfur colloid for a routine liver scan. The colloid concentration in the lungs was similar to that in the liver. (auth)

24868 CLINICAL EVALUATION OF AN INSTANT KIT FOR PREPARATION OF ^{99m}Tc-MAA FOR LUNG SCANNING. Chandra, R.; Shamoun, J.; Braunstein, P.; DuHov, O. L. (New York Univ. Medical Center). J. Nucl. Med.; 14: No. 9, 702-705(Sep 1973).

A commercially available kit for the preparation of ^{99m}Tc-MAA for lung scanning was evaluated in 45 patients. The effective half-life in the lungs of this preparation was found to be 236 ± 30 min in seven patients. The radiation dose/mCi to the lungs, liver, and kidneys is estimated to be 0.28, 0.08, and 0.16 rad, respectively, from the biological data obtained on seven patients. The preparation is very simple, and the use of ^{99m}Tc-MAA instead of ^{131}I-MAA resulted in improvement of image quality and reduction of the time of study as well as radiation dose to the patient. (auth)

24869 ORGAN DISTRIBUTION OF THE ^{99m}Tc-LABELED WHITE CELLS. Uchida, T.; Kariyone, S. (Kyoto Univ.). Nippon Ketsueki Gakkai Zasshi; 36: No. 1, 78-81(Feb 1973).

A method for labeling leukocytes in vitro with technetium-99m was described. Organ distribution of ^{99m}Tc-labeled leukocytes in patients with various diseases was presented by means of gamma-scintillation camera. Leukocytes separated in ACD solution were incubated with ^{99m}Tc for 30 min at 37°C. A 0.1 ml aliquot of 100 μg per ml stannous chloride solution in ACD was added to the leukocytes as a reducing agent. After incubation for 10 min at room temperature, the leukocyte suspension was washed twice with physiologic saline and 20 ml of resuspended labeled leukocytes were infused into the subject. The liver, spleen, and lungs were visualized as a significant site of the marginal pool. (auth)

24870 TOXICITY OF TRITIUM AND TRITIUM COMPOUNDS. Hamard, J. (CEN, Fontenay-aux-Roses, France). Bull. Inform. Sci. Tech. (Paris); No. 178, 79-82(Feb 1973). (In French).

The toxicity of tritium depends upon its physicochemical form. Tritium gas has a very low toxicity. However, it is slowly oxidized in the atmosphere and in the lungs where it forms tritiated water. Tritiated water accumulates in the liquids of the organism and

thereby results in the irradiation of most of the organism. Some of the parameters concerning the toxicity of tritiated water have recently been modified; no major changes have, however, been made in the definition of the maximum permissible concentration. Certain tritium-labeled organic molecules may also incorporate themselves in the organism. The toxicity of such substances is currently being studied. (FR)

24871 ELIMINATION OF INHALED PLUTONIUM OXIDE PARTICLES BY IN VIVO LUNG WASHOUT. Description of the Techniques Used. Nolibe, D. (Centre d'Etudes de Bruyeres-le Chatel, Montrouge, France). Compt. Rend., Ser. D; 276: No. 2, 225-228(8 Jan 1973). (In French).

The use of in vivo lung washout appears to be the only therapeutic technique capable of eliminating inhaled toxic substances, particularly in the case of highly carcinogenic soluble radioactive particles. This therapeutic technique has recently been applied to man in the case of an accidental inhalation of plutonium oxide. The systematic utilization of such a technique has necessitated experiments on baboon monkeys in which atmospheres charged with plutonium oxide particles having a mean diameter of 5μ were inhaled. The washouts were effected without problems, and a rapid physiological recovery achieved. (FR)

24872 RADIOIODINE UPTAKE VALUES IN EUTHYROID, NONGOITROUS, PREPUBERTAL CHILDREN IN GREECE. Anoussakis, C. (Children's Hospital, Athens); Liakakos, D.; Vlachos, P.; Matsioulas, P.; Ikkos, D.; Gonticas, S. Nucl.-Med.; 12: No. 1, 14-25(1973).

Thyroidal uptake of ^{131}I was measured in 50 euthyroid, nongoitrous Greek children aged 2 to 12 yrs (17 males and 33 females). The ^{131}I uptake values of Greek children (31.8 ± 1.81, 59.1 ± 2.17, and 60.2 ± 2.16 at 3, 24, and 48 hrs, respectively) are the highest recorded so far in the literature, a manifestation of the prevailing iodopenia in this country. Another manifestation of the iodopenia was the finding that in 41% of the prepubertal children the $PB^{131}I$ values at 48 hrs were larger than the upper normal limit of 0.4% of the dose/liter. Female children had significantly higher uptake values than males, the ratio of the mean values for females to the mean value for males being 1.34, 1.19, and 1.15 at 3, 24, and 48 hrs, respectively. Prepubertal children had significantly higher uptake values than postpubertal ones, this difference being most pronounced in females, in whom the mean ^{131}I uptake for the age group 12 to 20 was 30.5, 17.4, and 16.2% lower at 3, 24, and 48 hrs, respectively, in comparison with the mean of the prepubertal age group. (GE)

24873 DOSIMETRY OF ^{129}Cs AND ^{131}Cs. Chandra, R. (New York Univ., NY); Anger, R. T.; Sodd, V. J. Phys. Med. Biol.; 18: No. 3, 467-470(May 1973).

Criticism is made of a previous article by Anger and Sodd (Phys. Med. Biol.; 16: 698 (1971)), in which the radiation dose to various organs and to the total body after an intravenous injection of 1 mCi of ^{129}Cs and ^{131}Cs, respectively, was calculated. A correction is calculated for the dose to any given organ, taking into account the penetrating part of the radioisotope distributed in the rest of the body. For γ-energy ranges of 0.030 to 1.00 MeV tables are presented for the absorbed fraction for lungs, kidneys, and liver when the radioisotope is uniformly distributed in the rest of the body, and the dose to lungs, kidneys, and liver from a radioisotope distributed in the rest of the body. It is pointed out that it is a wrong assumption that the biological half-life of Cs in kidneys, liver, and heart is the same as in the whole body. It is claimed that extrapolation from animal retention curves would be more accurate, and estimates of kidney dose are given as 0.4 and 0.38 rad for ^{129}Cs and ^{131}Cs, respectively. Estimates of testes dose are given as 0.38 and 0.32 rad for ^{129}Cs and ^{131}Cs, respectively. Calculations for these were made by multiplying the specific concentration (μ Cig^{-1}) in the testes of a given animal species by the mass of the human organ. In a second letter to the editor, acknowledgment is made of the suggested improvements to the calculations, but it is pointed out that medical procedure can be made independently of dosimetry considerations, on the basis of the more favorable half-life and photon energies of ^{129}Cs. (UK)

24874 STUDY OF ACCIDENTAL CONTAMINATION BY TRITIATED WATER. Henry, P. (Centre de Marcoule, Bagnols-sur Ceze, France). Rayonnements Ionis. Tech. Mes. Prot.; No. 2, 91-103(Apr 1973). (In French).

The accident is described together with the way in which the internal contamination of the personnel exposed is evaluated: measurement of the tritium concentration of urine using liquid scintillation. The most interesting case of contamination was studied over a period of 275 days. The treatment is presented. The biological half-lives for elimination from the organism were studied and compared with other results. The equivalent dose delivered to the body water and the relative extent to which the long-life fraction is fixed in the tissue were studied. Legally defined criteria for exceptional cases of internal contamination and dose criteria for a 50-year period were used to establish permanent criteria for evaluating the level of an accidental contamination. (FR)

24875 MEASUREMENT OF THYROIDAL TECHNETIUM UPTAKE WITH THE GAMMA CAMERA AND COMPUTER SYSTEM. Atkins, H. L.; Klopper, J. F. (Brookhaven National Lab., Upton, NY). Amer. J. Roentgenol., Radium Ther. Nucl. Med.; 118: No. 4, 831-835(Aug 1973).

The determination of technetium-99m uptake in the thyroid can be a useful clinical method. The variation in time of peak accumulation in the thyroid is moderate. Continuous recording over the thyroid using a gamma camera and a data processing system, while time consuming, can improve the accuracy of these determinations compared to those performed with the rectilinear scanner. (auth)

24876 RATE OF ACCUMULATION OF TECHNETIUM-99m BY THE THYROID. Esser, P. D.; Atkins, H. L.; Robertson, J. S. (Brookhaven National Lab., Upton, NY). Amer. J. Roentgenol., Radium Ther. Nucl. Med.; 118: No. 4, 827-830(Aug 1973).

The accumulation of technetium in the thyroid for a period of 30 minutes was studied in 56 patients. The average maximum uptake occurred at 17.8 minutes. The distribution of the time to reach maximum intensity ranges from 6 to over 30 minutes. It is confirmed that using a 20 minute uptake is a reasonable clinical procedure. In addition, an attempt was made to fit the uptake curves with a simple expression of the type which might be obtained from a compartmental analysis. No correlation was obtained between the constant of the exponential and the clinical condition of the patients. (auth)

24877 CLEARANCE OF TECHNETIUM PERTECHNETATE FROM THE HIP JOINT WITH ARTHROSIS DEFORMANS. Tanaka, S.; Ito, T.; Hamamoto, K.; Torizuka, K. (Kyoto Univ.). Amer. J. Roentgenol., Radium Ther. Nucl. Med.; 118: No. 4, 870-875(Aug 1973).

In patients with osteoarthritis of the hip, technetium-99m pertechnetate was injected into the hip joint cavity under fluoroscopy, and the clearance was measured by scintillation counter. An obvious correlation with the clinical and roentgen findings was seen in the slope ratio of the radioisotope clearance rate when affected and healthy sides were compared. In prearthrosis and initial arthrosis, the slope ratio was usually more than 1.0 indicating a relative increase in the clearance rate on the affected side, while in advanced and terminal arthrosis, the slope ratio was usually less than 1.0 indicating a relative decrease in the clearance rate on the affected side. (auth)

24878 TOXICOLOGY OF RADIONUCLIDES. Stannard, J. N. (Univ. of Rochester, NY). Annu. Rev. Pharmacol.; 13: 325-357 (1973). (UR-3490-182).

A review of the literature on radionuclide toxicology is presented. Studies on carcinogenesis induced by alpha, beta, and gamma emitters are discussed. Reviews are presented of studies on neoplasms induced by the following alpha emitters: ^{226}Ra, ^{224}Ra, ^{210}Pb, ^{210}Po, ^{239}Pu, ^{238}Pu, ^{238}U, and thorotrast. The role of beta and gamma emitters as carcinogens is reviewed with regard to strontium and iodine isotopes. A review of dosimetry and dose-response relationships includes discussions of animal experiments and development of models for dose-effect relationships. A review of environmental aspects includes discussions of fallout from weapons testing, discharge of radionuclides from nuclear energy installations, evidence of effects from past activities, actual or potential release rates, the role of the ecosystem, and radionuclide effects on lower organisms. A discussion is given of the transmutation effect of tritium following entrance into the body as tritiated water or in organic form. (HLW)

Animals

Refer also to abstracts 24487, 24785, 24894, 24901, and 24913.

24879 (AEC-tr-7444, pp 198-201) PREVENTION OF THE ABSORPTION OF CESIUM-137 WITH COLLOIDAL-SOLUBLE FERROCYANIDES OF IRON, COBALT, AND NICKEL. Seletskaya, L. I.; Borisov, V. P. (Inst. of Biophysics, Moscow). Translated from Radiobiologiya; 13: No. 2, 313-315(1973).

Ferrocyanides of iron, cobalt, and nickel in the crystalline and colloidal-soluble forms were investigated to prevent the assimilation of radiocesium. It was established that the preparations in colloidal-soluble form proved 50 to 100% more effective than the usual preparations. (tr-auth)

24880 (CNEA-341) UPTAKE OF RADIOSTRONTIUM BY MARINE ORGANISMS. Cancio, D.; Llauro, J. A.; Ciallella, N. R.;

Beninson, D. J. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina)). 1973. 16p. (In Spanish). Dep. NTIS (U. S. Sales Only) $3.00.

The main objective was the determination of strontium-calcium discrimination factors and strontium concentration factors. Results were obtained from laboratory experiments with double tracer techniques and from systematics determinations of stable strontium and calcium contents in marine biota. Experiments were carried out with species usually found in the Argentine Atlantic shore areas including fishes, crustacea, molluscs, and algae. Laboratory experiments point out that with the double tracer techniques, discrimination factors can be determined even before equilibrium. All the tested species discriminated against strontium, and discrimination factors values ranging from 0.10 to 0.92 have been obtained. It was found that in fishes (Micropogon opercularis) the Sr–Ca ratio is uniform for different tissues. The same was observed for exoskeleton and soft tissues in crustacea. On the other hand molluscs present different values for soft tissues and shell. Discrimination factors obtained in field conditions (through stable strontium and calcium determinations) agree with laboratory results for fishes and molluscs; values are lower for crustacea and algae. The obtention of concentration factors through discrimination parameters, asserts equilibrium conditions and allows to extrapolate experimental results to natural conditions with less uncertainty. Strontium concentration factors obtained range from 2 to 10 for fishes, from 13 to 70 for crustacea and molluscs and from 0.2 to 70 for algae. (auth)

24881 RAPID ELIMINATION OF ^{137m}Ba FROM GUINEA PIG HEART MUSCLE CELLS. Edelmann, L.; Edelmann, H. (Univ. of Saarland, Homburg, Ger.). Biophysik; 10: No. 1, 88-101(1973).

Experiments concerning the disturbance of the ^{137}Cs to ^{137m}Ba equilibrium in muscle cells were performed with perfused guinea-pig hearts. It could be calculated that ^{137m}Ba is eliminated with a half-life of about 17 sec from the heart muscle cells into the coronary venous effluent. (auth)

24882 RESISTANCE OF RAT THYROID IODOPROTEIN TO PROTEOLYSIS FOLLOWING LARGE DOSES OF RADIOIODINE. Kobayashi, I.; Greer, M. A. (Univ. of Oregon, Portland). Endocrinology; 93: No. 3, 593-601(Sep 1973).

Intact iodine-replete or iodine-deficient rats were injected with doses of 10 to 500 μCi ^{131}I. One week later, they were injected with a tracer dose of ^{125}I 4 or 24 hr before autopsy. One thyroid lobe was examined histologically. The other lobe was homogenized and its resistance to 4-hr digestion with 1% pancreatin or with 0.003% pancreatin after pretreatment of the iodoprotein with 0.05M mercaptoethanol was studied. Distribution of both ^{131}I and ^{125}I radioactivity was also determined by quantitative chromatography after 24-hr digestion with 1% pancreatin. In both the iodine-replete and iodine-deficient rats, a dose of 250 or 500 μCi ^{131}I produced increased resistance to digestion in both the ^{131}I- and ^{125}I-labeled iodoprotein and a reduction in the percent of total chromatograph radioactivity of both labels in the iodothyronine component. There was no change in MIT/DIT or T_3/T_4 ratios in iodine-replete rats receiving any dose of ^{131}I. However, there was a marked decrease in these ratios for both ^{131}I and ^{125}I in the iodine-deficient rats receiving 500 μCi compared to those receiving 10 μCi. This change in the ratios in the iodine-deficient rats receiving 500 μCi ^{131}I is believed due to destructive release of large quantities of iodoprotein from the irradiated thyroid and reincorporation into thyroid iodoprotein of ^{127}I$^-$ released from deiodination of this iodoprotein. Hypophysectomized iodine-deficient rats were injected with doses of 10–500 μCi ^{131}I and their thyroid radioiodine content followed for 7 days. One hundred to 500 μCi ^{131}I caused a dose-related loss of radioiodine from the thyroid. The labeled iodoprotein remaining at 7 days was more resistant to digestion in rats given 250 and 500 μCi ^{131}I than in those given 10 μCi. Histologic evidence of irradiation damage was not seen in the rats receiving the lowest doses of ^{131}I and was much more severe in the central than in the peripheral portions of the thyroid lobe in those receiving the larger doses. Retention of iodoprotein in irradiation-damaged rat thyroids was apparently primarily limited to the larger peripheral follicles. (auth)

24883 EXPERIMENTAL COMPARISON OF RADIOACTIVE AGENTS FOR STUDIES OF THE PLACENTA. Mahon, D. F.; Subramanian, G.; McAfee, J. G. (Upstate Medical Center, Syracuse, NY). J. Nucl. Med.; 14: No. 9, 651-659(Sep 1973).

The localization of 15 different radiopharmaceuticals in the placenta, fetus, and various organs was studied by tissue radioassay in the pregnant rabbit. The highest placental concentration was obtained in the rodent with carrier-free ^{113m}In as labeled transferrin; however, even small amounts of carrier indium (10 μg/kg) lowered its placental uptake. Other transferrin-bound radiopharmaceuticals did not localize to the same degree in the placenta. In a comparison of five different radioactive colloids, only a radiocolloid of ^{159}Dy-gluconate exhibited a placental concentration comparable to labeled serum albumin, presumably due to the reticuloendothelial function of that organ. Six different short-lived radiopharmaceuticals were compared by scintillation camera imaging following successive intravenous administrations in a pregnant rhesus monkey near term. Images of the placenta were better with ^{99m}Tc-albumin than with ^{113m}In-transferrin, but the best images were obtained with ^{99m}Tc-labeled autologous red blood cells. Of two skeletal imaging agents, ^{99m}Tc-EHDP apparently crosses the placental barrier to enter the fetal skeleton to some degree whereas larger molecular weight ^{99m}Tc-polyphosphate does not. (auth)

24884 COMPARATIVE TOXICITY AND PHARMACODYNAMICS OF IONIC INDIUM CHLORIDE AND HYDRATED INDIUM OXIDE. Castronovo, F. P. Jr.; Wagner, H. N. Jr. (Johns Hopkins Medical Inst., Baltimore). J. Nucl. Med.; 14: No. 9, 677-682(Sep 1973).

Interest in the toxicity and pharmacodynamics of indium compounds resulted from their use as diagnostic radiopharmaceuticals. Indium-113 ($T_{\frac{1}{2}}$ 1.7 hr) is administered intravenously as ionic indium chloride, colloidal hydrated indium oxide, and macroaggregated ^{113}In–iron hydroxide. Indium-111 ($T_{\frac{1}{2}}$ 2.8 days) is also used in clinical nuclear medicine. Studies included determination of the (LD_{50}/4 days) of ionic and colloidal indium and a pharmacodynamic evaluation of tracer dose levels of these compounds using ^{114m}In ($T_{\frac{1}{2}}$ 50 days). Initial biological distribution, subsequent translocation, whole-body retention, and excretion were investigated. Colloidal hydrated indium oxide was found to be 40 times more toxic than ionic indium chloride, the principal damage being to the organs of the reticuloendothelial system. Ionic indium chloride caused acute tubular necrosis of the kidneys. Hydrated indium oxide accumulated primarily in the liver, spleen, and bone marrow and was mainly excreted in the feces. Ionic indium became protein bound after administration with subsequent translocation to the kidney and liver and was excreted mainly in the urine. (auth)

24885 USE OF SORBENTS OF NATURAL ORIGIN FOR TREATMENT OF INTERNAL RADIOCESIUM CONTAMINATION IN PIGS. Havlicek, F.; Hrusovsky, J. (Military Veterinary Research Inst., Prague). Vet. Med. (Prague); 18: No. 4, 213-218(Apr 1973). (In Czech).

Pigs were subject to trials undertaken to study the decontaminating effect of pumice rhyolite in peroral or intratracheal contamination. The highest effect was achieved in preventive or immediate post-contamination applications. The treatment may be started also some time after contamination, with due respect to the enteral cycle of radiocesium. Repeated application in the doses of 250 g and further daily applications of 100 g as a part of feed are suggested for practical treatment. No unfavorable side effects on the health of the experimental animals were observed during the trials. (auth)

24886 AFFINITY OF ^{57}Co-BLEOMYCIN TO MALIGNANT TUMORS. Kono, A. (Kyushu Univ., Fukuoka); Kojima, M.; Maeda, T. Rinsho Hoshasen; 18: No. 3, 195-196(Mar 1973). (In Japanese).

Thirty μCi of ^{57}Co-bleomycin was administered intraperitoneally to the Ehrlich ascites tumor bearing mouse. The distribution of radioactivity in the organs of the mouse was investigated by macroautoradiography 1 hr and 24 hrs after administration, while radioactivity in the urine and homogenate of tumor tissues was examined by thin-layer chromatography. The result was compared with those for ^{67}Ga-citrate and ^{67}Ga-bleomycin administration. One hr after ^{67}Ga-bleomycin administration, 40% of ^{67}Ga was found in the urine and almost all radioactivity was excreted after 24 hrs. In comparison of ^{57}Co-bleomycin, ^{67}Ga-citrate, and ^{67}Ga-bleomycin, the retention of ^{57}Co-bleomycin was highest after 1 hr in particular in the tumor with concentrations of 2 to 3 times that in the other two cases. The ^{57}Co-bleomycin had the highest affinity to the tumor. The level of radioactivity in the superior nucleus and cytoplasm fractions was the same as the level of DNA in those fractions in the case of ^{57}Co-bleomycin administration suggesting that ^{57}Co-bleomycin is bound with DNA. (JA)

24887 SOME FACTORS IN THE EFFECTIVENESS OF CYANOFERRATES USED FOR THE REMOVAL OF RADIOCESIUM FROM THE ORGANISM. Havlicek, F.; Hrusovsky, J. (Military Veterinary Research Inst., Prague). Vet. Med. (Prague); 18: No. 4, 219-228(Apr 1973). (In Czech).

Trials were undertaken in vitro to study insoluble binary cyanoferrates for the effect of pH and competitive ions (Na, K, Ca) on Cs capture. Furthermore, cyanoferrates were tested in trials in rats where the compounds were used as supplements to diet. Their

decontaminating effect was compared with that of $K_4Fe(CN)_6$ with varying content of cellulose in diet. On the basis of the results, potassium cyanoferrate is suggested as a decontaminant for the therapy of the internal radiocesium contamination of the organism. (auth)

24888 DELAY OF TIME BETWEEN MAXIMUM SPECIFIC PHOSPHORUS-32-ACTIVITIES OF FECES AND URINE IN GROWING PIGS AFTER PARENTERAL INJECTION OF RADIOPHOSPHORUS. A Contribution for Determination of Endogenous Fecal Phosphorus. Vemmer, H. (Forschungsanstalt fuer Landwirtschaft, Brunswick-Voelkenrode, Ger.). Z. Tierphysiol. Tierernaehr. Futtermittelk.; 31: No. 3, 159-164(1973). (In German).

In two experiments, growing pigs were injected parenterally with phosphorus-32. Difference of time between injection and excretion of the fecal sample with maximum specific activity was measured. This interval was influenced by changes in food composition, but there was no difference between pigs of 48 kg and of 80 kg live-weight if food composition and daily food intake were constant. Consequences of the delay of excretion on the determination of endogenous fecal phosphorus and intestinal phosphorus absorption are discussed. (auth)

24889 INDUCTION OF TUMORS INVOLVING BONE IN BEAGLES FED TOXIC LEVELS OF STRONTIUM-90. Pool, R. R.; Williams, R. J. R.; Goldman, M. (Univ. of California, Davis). Amer. J. Roentgenol., Radium Ther. Nucl. Med.; 118: No. 4, 900-908(Aug 1973).

Bone tumors were induced in 22 beagles following ingestion of ^{90}Sr during the first 1.5 years of life. The tumors involving the bone were related to daily dosage, both with respect to age at first recognition and location of lesion. These tumors developed in 11 of 19 dogs receiving ~20,000 mrad/day to bone; 9 of 47 receiving ~7,000 mrad/day; and 2 of 56 receiving ~2,000 mrad/day. No tumors have developed in 160 control or 251 comparable ^{90}Sr dogs fed at lower levels. The temporal, spatial, and morphologic tumor pattern, when related to dose rate, suggests that the risk for tumor production may be a function of rate and degree of cellular repair which, in turn, is dependent on the severity of prior radiation injury. (auth)

New Tracer Techniques

Refer also to abstracts 24327, 24348, 24361, 24371, 24487, 24858, 24860, 24869, 24876, 24877, and 24886.

24890 (BNL-18052) DIAGNOSTIC AND THERAPEUTIC MEDICAL APPLICATIONS FOR ISOTOPES. Atkins, H. L. (Brookhaven National Lab., Upton, N. Y.). 1973. 60p. (CONF-730611-17). Dep. NTIS $5.00.

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973).

The value of scintiscanning for the diagnosis and evaluation of myocardial perfusion in patients with coronary artery disease is discussed. The advantages and disadvantages of methods using ^{133}Xe washout or ^{99m}Tc- and ^{131}I-macroaggregated human serum albumin as tracers are compared. A number of other methods under investigation are also discussed briefly. Methods for adrenal gland imaging and tumor localization by scanning following the administration of various radioisotope-labeled compounds are reviewed. The value of ^{131}I-iodocholesterol scanning for the identification of residual adrenal tissue following surgery is discussed. (CH)

24891 (COO-3141-31) LOCALIZATION OF ANTIBODIES IN SPONTANEOUS AND INDUCED TUMORS. Final Report. Pressman, D. (Roswell Park Memorial Inst., Buffalo, N. Y.). 31 Oct 1972. Contract AT(11-1)-3141. 31p. Dep. NTIS $3.75.

A new technique was developed for radio-immunoassay of specific antigens in tissue sections; the reactivity of antiserum globulin was determined using ^{125}I-labeled IgG from antiserum and ^{131}I-labeled IgG from normal serum. Programs were developed for computation of results of immune assays using ^{131}I, ^{125}I, and ^{130}I as a triad and two of the iodines as a diad. Radiolabeled tissue antibodies were used to determine the antigenic composition of tumors and differences between tumors and normal tissues. Other studies were conducted on antibodies to cultured cells, localization of normal serum globulin components, and distribution of histocompatibility antigens in tissues. (HLW)

24892 (TID-26404) BIOLOGICAL EFFECTS OF RADIATION AND RELATED BIOCHEMICAL AND PHYSICAL STUDIES. Proposal 3. Metabolic studies in Cancer with Radioactive Isotopes. Progress Report, May 1, 1971–Apr 30, 1973. Laughlin, J. S.; Myers, W. P. L. (Sloan-Kettering Inst. for Cancer Research, New York). 31 May 1973. Contract AT(11-1)-3521. 98p. Dep. NTIS $7.00.

Data processing systems were developed for the computer analysis of scintiscan data obtained using short-lived radionuclides as tracers and dual γ cameras. The application of the modulation transfer function for the improvement of radionuclide scintiscan data is discussed. A radioisotope scanner was calibrated for the measurement of absolute organ activity following administration of tracer doses of ^{51}Cr, ^{67}Ga, ^{52}Fe, ^{18}F, or ^{13}N as $^{13}NH_3$. Pulmonary function studies, using ^{15}O-labeled oxygen as tracer, were carried out in dogs. Human patients with aberrant hematological dyscrasias were studied scintigraphically using ^{52}Fe uptake in the reticuloendothelial system and spleen sequestration of ^{51}Cr-labeled erythrocytes; ^{18}F was evaluated as a bone scanning agent in human patients with a variety of bone lesions; and ^{67}Ga citrate was evaluated for scintigraphic tumor localization in soft tissues of human patients; the effects of antitumor therapy on the local kinetics of ^{47}Ca and ^{85}Sr in tumor-involved bone were studied in human patients; and the effects of phosphate therapy on Ca metabolism and kinetics in patients with primary hyperthyroidism or bone metastases were evaluated scintigraphically using ^{47}Ca as tracer. ^{47}Ca was also used as a tracer in studies on bone mineralization in patients. The feasibility of using neutron activation of ^{37}Ar for measurements of total body calcium in patients was investigated and preliminary results are reported. The effectiveness of ^{35}S-sulfate for the treatment of advanced chondrosarcoma or chordoma that could not be removed surgically was evaluated. Bone marrow toxicity was the limiting factor in this mode of therapy. (CH)

24893 (UCLA-12-919, pp 66-78) CLINICAL APPLICATIONS. 1973.

In annual progress report for the period ending June 30, 1973.

Progress is reported on the following research projects: correlation of normal lung scans with pulmonary function tests; diagnosis of intravascular clots using ^{99m}Tc macroaggregates of albumin; radiopacification of intravascular clot by intravenous injection of tantalum particles; reliability and usefulness of thrombosis scanning using ^{99m}Tc-macroaggregates of albumin; MAA studies of electrophoretic mobility and charge in relation to thrombosis affinity, comparison of radiopague tantalum particles with ^{99m}Tc-MAA and venography for demonstration of intravascular thrombosis; detection of intravascular thrombosis with radiolabeled streptokinase; uptake of ^{125}I-labeled fibrinogen in patients with thrombophlebitis; the rapid preparation of ^{99m}Tc-labeled macroaggregates of albumin; distribution of inhaled grass pollen and its relation to bronchospasm; quantitative cisternography with ^{111}In-DTPA; significance of choroidal uptake of ^{99m}Tc-pertechnetate on brain scans; ^{111}In-bleomycin scanning for detection of subclinical metastatic cancer; and use of ^{133}Xe and ^{99m}Tc for comparing heart chamber dilution curves and pulmonary dilution curves for diagnosis of congenital heart disease. (HLW)

24894 (UCLA-12-919, pp 83-86) RADIOPHARMACEUTICAL DEVELOPMENT. 1973.

In annual progress report for the period ending June 30, 1973.

Progress is reported on the following research projects: biological dynamics of ^{18}F- and ^{11}C-labeled carboxylates and alcohols; rapid synthesis of high-specific-activity, biologically active ^{18}F-fluoroaliphatic analog compounds; radioiodinated medium and long chain fatty acids; preparation, biological dynamics, and uptake of ^{99m}Tc-tetracycline in damaged myocardium; and particulate radiodiagnostic agents. (HLW)

24895 (UCLA-12-919, pp 87-91) BIOMEDICAL CYCLOTRON OPERATIONS. 1973.

In annual progress report for the period ending June 30, 1973.

The Biomedical Cyclotron Facility is being used to produce radionuclides for clinical research and physiologic studies in nuclear medicine. The following radionuclides are discussed with regard to their use in nuclear medicine research; ^{43}K, ^{129}Cs, ^{111}In, ^{18}F, ^{13}N, ^{11}C, ^{97}Ru, ^{95}Tc, ^{117}Sb, ^{121}Te, ^{167}Tm, ^{195m}Pt, ^{127}Cs, and ^{15}O. (HLW)

24896 NEW LUNG SCANNING AGENT: ^{99m}Tc(Sn)MAA. Robbins, P. J.; Fortman, D. L.; Lewis, J. T. (Univ. of Cincinnati). Int. J. Appl. Radiat. Isotop.; 24: No. 8, 481-483(Aug 1973).

A method is described for the preparation of a lung scanning agent with a suitable biological half-life that consists of the formation of macroaggregated albumin and stannous-hydroxide colloid as components of a system of pretested reagents for the preparation of ^{99m}Tc(Sn)MAA. The stannous hydroxide functions as a carrier for ^{99m}Tc after the denatured albumin has absorbed the colloid. This is similar to preparation of ^{99m}Tc HAM (Radiology; 99: 613 (1971)). Preparation of the reagents in pre-packaged form, their use, some biological and physical properties, and serial images obtained with the final product are described. (UK)

24897 PREPARATION OF ^{131}I-LABELLED M-IODOHIPPURIC ACID AND ITS BEHAVIOUR IN KIDNEY FUNCTION STUDIES COMPARED TO O-IODOHIPPURIC ACID. Elias, H.; Arnold, C.; Kloss, G. (Technische Univ., Darmstadt, Ger.). Int. J. Appl. Radiat. Isotop.; 24: No. 8, 463-469(Aug 1973).

A technique for iodine labeling of aromatic iodine compounds is described and applied to the preparation of ^{131}I-labelled m-iodohippuric acid (m-IHA). Being stored in saline solution, labelled m-IHA is more stable with respect to formation of free radioiodide than o-iodohippuric acid (o-IHA). Detailed animal experiments in rats and dogs lead to the conclusion that there are no significant differences in the behavior of o-IHA and m-IHA. (auth)

24898 COMPARISON OF THE USE OF ^{52}Fe AND ^{111}In FOR HEMOPOIETIC MARROW SCANNING. Rayudu, G. V. S.; Shirazi, S. P. H.; Fordham, E. W.; Friedman, A. M. (Presbyterian-St. Luke's Hospital, Chicago). Int. J. Appl. Radiat. Isotop.; 24: No. 8, 451-454(Aug 1973).

The results obtained on tests on hemopoietic marrow scanning in experimental animals using ^{52}Fe(II) citrate and $^{111}InCl_3$ are compared. It was found that while the target/nontarget ratios are higher for the results of the ^{52}Fe experiments very comparable results can be obtained with ^{111}In. (auth)

24899 PREPARATION OF ^{125}I-LABELLED STEROID DERIVATIVES FOR RADIOIMMUNOASSAY. Massaglia, A.; Barbieri, U.; Siri-Upathum, C.; Vitali, R. (Societa Ricerche Impianti Nucleari, Saluggia, Italy). Int. J. Appl. Radiat. Isotop.; 24: No. 8, 455-462(Aug 1973).

Using 1-ethyl-3-(3-dimethylaminopropyl) carbodiimide as coupling agent, the TME (tyrosine methyl ester) derivatives of testosterone, 11α-hydroxyprogesterone, cortisol, and aldosterone were synthesized. The monoiodinated forms of these compounds, isolated after labelling with ^{125}I at 400 to 500 mC/mg, show a high stability on storage, suggesting their suitability as tracers for radioimmunoassay. (auth)

24900 RADIOIMMUNOASSAY AND RELATED METHODS. Hawker, C. D. (Upjohn Co., Kalamazoo, MI). Anal. Chem.; 45: No. 11, 878A-880A; 882A; 884A; 886A; 888A; 890A(Sep 1973).

Basic principles and methodologies of radioimmunoassay are considered and examples are given of numerous applications. The related methods considered include competitive protein-binding assay, radioenzymatic assay, and immunoradiometric assay. (DHM)

24901 IS TSH-STIMULATED THYROID HORMONE RELEASE INHIBITED BY IODIDE? Nagataki, S.; Uchimura, H.; Masuyama, Y.; Kosaka, K. (Tokyo Univ.). Endocrinology; 93: No. 3, 532-539(Sep 1973).

The effect of iodide on TSH-stimulated thyroid hormone release in the McKenzie bioassay was studied. When mice were given KI (0.01 or 10 mg/ml in drinking water) for 24 hr before TSH, thyroid ^{125}I release in response to TSH expressed as the percent increase in serum ^{125}I (2 hr value/0 hr value) was significantly inhibited, an effect in good agreement with previously reported results. However, the absolute increase in serum ^{125}I (2 hr value−0 hr value) was not changed by KI-treatment. In KI-treated mice, the concentration of ^{125}I present in the serum before TSH injection was significantly higher than that in the control mice. Methimazole (0.02 mg/ml in drinking water) abolished the inhibitory effect of iodide on the percent increase in serum ^{125}I in response to TSH by abolishing the increase in the concentration of serum ^{125}I before TSH. Changes in serum ^{125}I-PBI were essentially the same as those in serum ^{125}I. These results suggest that the inhibitory effect of iodide on the percent increase in serum ^{125}I in response to TSH is not due to a smaller increase in serum ^{125}I after TSH, but is due to higher values of the serum ^{125}I present before TSH injection, that is, iodide does not inhibit the TSH-stimulated thyroid hormone release, serum ^{125}I concentration is increased by the treatment with iodide at least in the McKenzie assay, organification of excess iodide is necessary for this increase in serum ^{125}I in response to iodide. (auth)

24902 HETEROLOGOUS RADIOIMMUNOASSAY FOR FOLLICLE-STIMULATING HORMONE: APPLICATION TO MEASUREMENT OF FSH IN THE OVINE ESTROUS CYCLE AND IN SEVERAL OTHER SPECIES INCLUDING MAN. Salamonsen, L. A. (Prince Henry's Hospital, Melbourne); Jonas, H. A.; Burger, H. G.; Buckmaster, J. M.; Chamley, W. A.; Cumming, I. A.; Findlay, J. K.; Goding, J. R. Endocrinology; 93: No. 3, 610-618(Sep 1973).

A heterologous radioimmunoassay system, using an antiserum to human FSH in combination with radioiodinated ovine FSH was highly specific for FSH for a number of species, and was used to measure plasma FSH levels in sheep, rat and man in a range of physiological states. Within-assay coefficient of variation (CV) was <10% over the range 35−500 ng FSH/ml and between-assay CV was 15%. Sensitivity was 1.3 ng NIH-FSH-S6 per tube and mean recovery of FSH added to plasma was 98%. Specificity was demonstrated by the finding of parallel inhibition curves between serial dilutions of plasma from an oophorectomized ewe and standard ovine FSH, and by the failure of ovine LH, GH, prolactin and albumin, human LH, TSH, hCG, bovine LH and GnRH to show significant inhibition. Ewes were bled at 2-hr intervals for 4 days over various stages of the estrous cycle and the samples assayed for FSH and LH. Sharp peaks of FSH, ranging from 80−150 ng/ml NIH-FSH-S6 were detected at estrus, coinciding with the preovulatory LH peak. For the remainder of the cycle, FSH appeared to be secreted as surges of variable duration with short troughs and extended peaks ranging from less than 15 ng/ml to 110 ng/ml. During the luteal phase plasma LH remained at basal levels and appeared to be regulated independently of FSH. (auth)

24903 EFFECTS OF TSH ON THE CHEMICAL COMPOSITION OF ORBITAL TISSUE IN GUINEA PIGS. Andrews, A. D.; Dunn, J. T. (Univ. of Virginia, Charlottesville). Endocrinology; 93: No. 3, 527-531(Sep 1973).

Female guinea pigs were injected either with saline, with thyroxine, or with varying doses of TSH. Following a single ip injection of Na_2 (^{35}S)O_4, the content of ^{35}S was determined for the Harderian gland, ventral lacrimal gland, and serum. Specific glycosaminoglycan fractions were isolated from the Harderian gland using successive columns of cetylpyridinium chloride-cellulose and ECTEOLA, and were assayed for levels of hexosamine and of ^{35}S. The following results were obtained: TSH increased the ^{35}S content of the serum, the Harderian gland, and the ventral lacrimal gland, while T_4 had no effect; TSH increased the proportion of total tissue ^{35}S in chondroitin sulfate and decreased it in keratan sulfate; the hexosamine content of the Harderian gland was increased by TSH, but not by T_4; TSH increased hexosamine levels in the hyaluronic acid, chondroitin sulfate, and glycoprotein fractions of the Harderian gland, and decreased them in the keratan sulfate fraction. In experimental exophthalmos TSH has multiple effects, which include changes in the tissue content of glycosaminoglycans, sulfate, and the carbohydrate portion of glycoproteins. (auth)

24904 LABELING OF MAMMALIAN NUCLEATED CELLS WITH ^{99m}Tc. Gillespie, G. Y.; Barth, R. F.; Gobuty, A. (Univ. of Kansas Medical Center, Kansas City). J. Nucl. Med.; 14: No. 9, 706-708(Sep 1973).

A rapid and simple method for labeling mammalian nucleated cells with ^{99m}Tc is described. A wide variety of tissue culture cells of mouse and human origin as well as lymphocytes isolated from peripheral blood were labeled without appreciable loss of viability. Optimum labeling was obtained by incubating viable cells suspended in a balanced salt solution with 10 mCi ^{99m}Tc and 100 μg Na_2CrO_4 for 15 min at 37°C followed by reduction with 0.2% $SnCl_2$ solution. Serum protein interfered with the labeling process. 10,000 viable cells gave between 1.2 and 6×10^5 cpm immediately after labeling. Mammalian nucleated cells retain approximately 90% of the bound radioisotope when injured or killed, and that which is released does not appear to be in a reusable form. Labeling with ^{99m}Tc had no consistent effect on the cells' ability to synthesize DNA or proteins. (auth)

24905 TUMOR SCANNING WITH ^{57}Co-BLEOMYCIN. Maeda, T. (National Hospital of Kyushu Cancer Center, Fukuoka). Rinsho Hoshasen; 18: No. 3, 197-200(Mar 1973). (In Japanese).

Cobalt-57-labeled bleomycin (^{57}Co-BLM) was made by labeling BLM (5 mg: 7.5 mg potency) (pH 6 to 7) with $^{57}CoCl_2$ (320 to 500 μCi) and was checked by radiochromatography. After sterility was confirmed, the pyrogen test was performed and the solution was stored in the frozen state. It was dissolved in 10 cc of glucose solution and injected intravenously to 27 clinical cases with various diseases. Scintiscanning was performed 6 to 24 hrs after injection. In one clinical case with pulmonary cancer (69 yr-old man), the picture obtained at 6 hrs after injection was not clear. After 24 hrs the clear lesion, kidney, and the bladder were observed, proving ^{57}Co-BLM useful for detecting lesions in the liver and pancreas. In a patient with gastric cancer and spine metastasis (20 yr-old woman), bone destruction of the right pelvic region, which was not detected by x-ray diagnosis, was revealed by ^{57}Co-BLM examination. The decrement curve of the radioactivity was analyzed in the urine and blood after intravenous injection of ^{57}Co-BLM. The half-life of the radioactivity in the blood had two phases, 6 hrs and 1.3 hrs. The excretion rate in the urine was 85% after 24 hrs. The exposure dose was estimated to be less than 2 rads in the kidney and less than 20 mrads in the whole body (^{57}Co-BLM per 1 mCi). This method has the following advantages: long physical half-life of ^{57}Co, no radioactive decay of ^{57}Co-BLM, and gamma ray energy suitable for the detector. However, exposure dose, uptake by diseases other than tumors, effects of chemo- and radiotherapy on ^{57}Co-BLM uptake, and dif-

ferences between the mechanism of the uptake of ^{67}Ga and ^{169}Yb should be studied further. (JA)

24906 SCINTIGRAPHIC TESTS. Stigliano, G.; Benedetti, G. A. Ann. Med. Nav.; 76: No. 5, 511-517(1971). (In Italian).

The latest technique in scintiscanning, done by gamma camera, is described. The method appears to be a noteworthy improvement in radiodiagnosis as it is perfectly reliable in spite of the speed of its execution, which brings a reduction of the radiation dose to the patients and an increased tolerance. (INIS)

24907 ESTIMATION OF RELATIVE CHANGES IN RESTING MUSCLE BLOOD FLOW BY ^{133}Xe WASHOUT: THE EFFECT OF OXYGEN. Hansen, M.; Madsen, J. (Univ. of Copenhagen). Scand. J. Clin. Lab. Invest., Suppl.; 31: No. 2, 133-139(Mar 1973).

Xenon-133 washout from resting anterior tibial muscle was studied in the 10- to 30-minute period after injection of ^{133}Xe. The elimination curves were strictly monoexponential but presented a slight spontaneous decrease in rate constant during the period. An experimental design is presented, which permits the detection of small, induced changes in muscle blood flow despite this spontaneous decrease in rate constant. Errors in the determination of resting muscle blood flow from ^{133}Xe washout are discussed. Relative changes in resting muscle blood flow may be overestimated when calculated from changes in ^{133}Xe elimination rate constants. Oxygen breathing at 1 atm was shown to reduce resting muscle blood flow. (auth)

24908 RADIOISOTOPE CLEARANCE TECHNIQUE FOR MEASUREMENT OF DISTAL BLOOD PRESSURE IN SKIN AND MUSCLES. Holstein, P.; Lassen, L. A. (Bispibjerg Hospital, Copenhagen). Scand. J. Clin. Lab. Invest., Suppl.; 31: 143-147(1973).

The local perfusion blood pressure in muscles can be measured by a radioisotope clearance technique employing ^{133}Xe. The critical organ in wound healing, e.g., in ischemic ulcers or amputation stumps, is the skin, and the technique has been adapted for measuring the cutaneous perfusion blood pressure using $^{125,131}I$. In order to measure the exact counter-pressure direct to the skin depot, a thin-walled PVC bag was interposed between an ordinary blood-pressure cuff and the pupule and filled with air or water to form a slack cushion and connected to a manometer. The results obtained by this method were compared with results obtained with the strain gage technique, and good agreement was found. The isotope technique is especially useful in the quantitative diagnosis of legs with the most serious degrees of obliterative vascular disease. (JIW)

24909 PRODUCTION OF DOUBLE LABELLED (^{14}C,^{15}N) WHEAT STRAW FOR STUDIES ON ORGANIC FERTILIZATION. Danneberg, O. H. (Landwirtschaftlich-Chemische Bundesversuchsanstalt, Vienna); Roth, K. Landwirt. Forsch.; 25: No. 3, 257-265(1972). (In German).

The production of nearly 3 kg of uniformly ^{14}C, ^{15}N labeled straw (124 μCi ^{14}C/g C, 14.88 Atom% ^{15}N) was carried out by growing spring wheat in an atmosphere containing $^{14}CO_2$ and on nutrient solutions with ^{15}N labelled nitrates. A method for reprocessing of up to 75% of the nitrates not taken up by the plants is given. The stages of development of wheat, the composition and the label of the yielded material are given in tables. A small field experiment with double labeled straw to study its transformation in the soil started in autumn 1970. (auth)

24910 RADIOIMMUNOELECTROPHORESIS IN THE DETERMINATION OF INSULIN BINDING TO IgG. Methodological Studies. Christiansen, A. C. (Novo Research Inst., Bagsvaerd, Denmark). Horm. Metab. Res.; 5: No. 3, 147-154(1973).

A new method, based on radioimmunoelectrophoresis, for the determination of insulin binding to IgG is described in detail. Various physical and chemical factors influencing the binding of insulin in vitro were studied. The test itself and the equipment used for electrophoresis are described in detail. Several parameters influencing the insulin binding in the test are investigated in vitro, such as the effect of the pH-value of the buffer solution; the time of incubation and electrophoresis, and the temperature. The method, which also enables the determination of the maximum insulin-binding capacity, is considered to be specific and simple. The sensitivity and reproducibility of the method are adequate for research and routine work. (GE)

24911 NUCLEAR MEDICINE IN NEUROLOGICAL DIAGNOSIS. Morley, J. B. Med. J. Austr.; 2: No. 2, 81-85(14 Jul 1973).

A review is made of the development of the use of different radioisotopes for scanning of the cerebral region. (AT)

24912 LOCAL KINETICS OF ^{87m}Sr IN JOINT DISEASES IN COMPARISON WITH THE RESULTS OF ^{113m}In. Buell, U. (Univ., Munich); Frey, K. W.; Schattenkirchner, M. Fortschr. Geb. Roentgenstr. Nuklearmed.; 119: No. 1, 91-100(1973). (In German).

The consecutive application of ^{113m}In and ^{87m}Sr with uptake measurements makes it possible to use a subtraction method from which the ^{87m}Sr distribution can be calculated in the soft tissue and bone pool, as well as in the blood in the joint. The inflammatory changes in the knees of 15 patients with chronic polyarthritis showed a ^{87m}Sr concentration at 19 min after injection that was twice that of normals. Two hours after injection, the ^{87m}Sr in the blood of the joint was <0.067 of the soft tissue and bone activity. The concentration of ^{87m}Sr around joints suffering from chronic polyarthritis depends not only on the extent of the radiologically demonstrable bone changes, but also on the degree of soft tissue swelling. Measurements on 56 unilaterally involved joints (chronic polyarthritis, arthrosis) showed that the use of ^{113m}In (scans and uptake measurements) permits a distinction between arthrosis and arthritis. The value of quantitative parameters for determining the rate of ^{87m}Sr storage (relative difference in soft tissue-bone activity) and of comparison of the two sides is discussed. (auth)

24913 INFLUENCE OF EXOGENOUS THYMIDINE CONCENTRATION ON THE INCORPORATION OF LABELED THYMIDINE AND IODODEOXYURIDINE, AND ON GROWTH OF JU56 CELLS IN VITRO. Moore, R. C.; Martin, R. F.; Hodgson, G. S. (Cancer Inst., Melbourne). Aust. J. Exp. Biol. Med. Sci.; 51: No. 2, 169-179(Apr 1973).

The simultaneous incorporation of tracer amounts of tritiated thymidine and ^{125}I-5-iodo-2′ deoxyuridine was measured during short term in vitro incubation of the permanent cell line JU56 in the presence of increasing concentrations of unlabeled thymidine. As unlabeled thymidine concentration increased in the range 5×10^{-8} M to 4×10^{-5} M, uptake of both tracers decreased in parallel. The extent of the decrease indicated that a rise in the contribution of exogenous thymidine to DNA synthesis had occurred. At higher concentrations of unlabeled thymidine when DNA synthesis began to decline the incorporation of ^{125}I-5-iodo-2′ deoxyuridine decreased more than that of tritiated thymidine. In an experiment using both tracers in the presence of 10^{-6} M unlabeled thymidine it was found that the ratio of the fractions of each tracer taken up from the medium was not significantly different from unity, if a correction was made for the inorganic ^{125}I contaminating the ^{125}I-5-iodo-2′ deoxyuridine preparation used. (auth)

24914 EXPRESSION OF ENDOGENOUS RNA C-TYPE VIRUS GROUP-SPECIFIC ANTIGENS IN MAMMALIAN CELLS. Stephenson, J. R.; Aaronson, S. A. (National Cancer Institute, Bethesda, MD). J. Virol.; 12: No. 3, 564-569(Sep 1973).

Highly sensitive and specific radioimmunoassays are described for quantitation of the intraspecies determinants of several mammalian C-type viral group-specific (gs) antigens. An interspecies (gs-3) immunoassay was developed, which has both the broad reactivity and great sensitivity necessary for detection of C-type viruses where intraspecies gs assays are not available. By using these immunoassays, the expression of endogenous virus-specified gs antigens in mammalian cells of different species has been studied. Whereas mouse gs antigen was clearly detectable in tissue culture cells of several mouse strains, the respective gs antigens of rat, cat, Chinese hamster, woolly monkey, and gibbon ape were not detectable in cells of those species, using assays of comparable sensitivity. Thus, differences exist in the level of endogenous virus expression in cells of different mammalian species. (auth)

24915 SIMPLE AND INEXPENSIVE BREATHING SYSTEM FOR XENON 133 VENTILATION STUDIES. Nuclear Medicine Technical Note. DHEW Publication No. (FDA) 74-8001. Cincinnati; Public Health Service (1973). 4p.

An inexpensive and reusable closed breathing system is described. An essential element of the design is the modified Douglas two-way valve, which directs the patients' inspiration in through one side of the valve only and the expiration out through the other side. This system can be used with xenon-133 either dissolved in solution and injected intravenously into the patient or as a gas injected into the tubing immediately before the intake side of the Douglas valve. (MCG)

24916 METABOLISM OF CHOLESTANE-3-ONE-4-^{14}C TO 5α-CHOLESTANE-3β-OL-4-^{14}C IN RAT LIVER. Minegishi, K. (Nihon Univ., Tokyo). Nichidai Shigaku; 46: No. 1, 15-18(Jan 1972). (In Japanese).

A 5μCi dose of cholestanone-4-^{14}C (5μCi/0.1 ml of 50% ethanol) was injected intraperitoneally to the albino rat. Three hours after injection, it was sacrificed and the liver was extracted. On examination with the use of silica gel column chromatography, radioactivity was found in the β-cholestanol fraction, cholestanone fraction, and in an unidentified fraction eluted between these two fractions. The radioactive substance in the β-cholestanol fraction obtained by column chromatography was purified by thin-layer chromatography. The radioactive substance was identified as β-cholestanol-4-^{14}C by the carrier

dilution method. It is considered that cholestanone can be easily transformed into β-cholestanol in vivo in albino rats. (JA)

24917 AUTORADIOGRAPHIC STUDY OF THE EFFECT OF CALCIUM ON THE CATION TRANSPORT IN THE LENS. Yuge, T.; Takeda, H.; Tani, M. (Kyoto Prefectural Univ. of Medicine). Nippon Ganka Gakkai Zasshi; 77: No. 2, 62-65(Feb 1973). (In Japanese).

Pairs of albino rabbit lenses were incubated at 37°C in Krebs–Ringer–Bicarbonate solution with and without calcium and autoradiography of ^{22}Na and ^{86}Rb and ^{45}Ca was performed in vitro. Autoradiography of ^{22}Na and ^{86}Rb in rabbit lenses incubated in vitro showed the higher uptake of ^{22}Na in the posterior cortical layer than in the anterior, and the higher uptake of ^{86}Rb in the anterior cortical layer than in the posterior. Sodium-22 is assumed to enter from the anterior surface of the lens and ^{86}Rb, from the posterior. The uptake of ^{22}Na increased both in anterior and posterior cortical layer and the regional difference in the uptake of ^{22}Na obscured, when the lens was incubated in the absence of calcium. Uptake of ^{86}Rb also increased but there still remained the regional difference. These changes are assumed to be caused by the increased permeability in the calcium-free medium, and the increased diffusional influx obscured the regional differences in ^{22}Na and ^{86}Rb uptake caused by the active transport. Autoradiography of ^{45}Ca was also performed in vitro. Calcium-45 accumulated specifically at the capsule or subcapsular layer. This suggests that the site to control the permeability of the lens is located at the superficial subcapsular cortical layer. (auth)

24918 RAPID SIMPLE IMPROVED METHOD FOR THE PREPARATION OF ^{99m}Tc RED BLOOD CELLS FOR THE DETERMINATION OF RED CELL VOLUME. Eckelman, W. C.; Reba, R. C.; Albert, S. N. (Washington Hospital Center, DC). Amer. J. Roentgenol., Radium Ther. Nucl. Med.; 118: No. 4, 861-864(Aug 1973).

An improved method of labeling red blood cells with ^{99m}Tc was developed. The labeling technique uses a citrate anticoagulant with a strong buffering capacity. This allows the stannous chloride reducing agent to be prepared as a stock solution. In comparison to other related methods, larger volumes of the reducing material and pertechnetate are used which results in better mixing with no decrease in yield. Only 2 centrifugation steps are required to obtain approximately 40 per cent yield with whole blood; the entire procedure takes approximately 30 minutes. Red blood cell volumes were determined simultaneously in 35 patients using ^{99m}Tc and ^{51}Cr. The difference between individual measurements was not clinically or statistically significant. This procedure is ideal for pediatric patients because of the low radiation dose of ^{99m}Tc. It is also advantageous because of the good counting statistics and rapid physical decay of the ^{99m}Tc isotope, which allows for small blood samples and repeated studies. Likewise, accurate and precise blood volume in small animals, e.g., rat, guinea pig, rabbit, etc., can be conveniently accomplished. (auth)

24919 EFFECT OF REACTIVE HYPEREMIA ON THE DISTRIBUTION OF RADIOACTIVE MICROSPHERES IN PATIENTS WITH PERIPHERAL VASCULAR DISEASE. Siegel, M. E.; Giargiana, F. A. Jr.; Rhodes, B. A.; White, R. I. Jr.; Wagner, H. N. Jr. (Johns Hopkins Medical Institutions, Baltimore). Amer. J. Roentgenol., Radium Ther. Nucl. Med.; 118: No. 4, 814-819(Aug 1973).

Using intraarterial injections of ^{99m}Tc and ^{113m}In labeled albumin microspheres it is possible to generate, employing a rectilinear scanner, comparative peripheral perfusion scans at rest and with the vasculature under stress. The most reliable means of producing significant vasodilatation, reactive hyperemia, was chosen as the stress. The perfusion scans obtained, when compared, demonstrate the dynamic changes that occur in peripheral perfusion when stressed. Although clinical experience is limited, the procedure may prove to be both diagnostically and prognostically significant in the evaluation of peripheral vascular disease. (auth)

MATERIALS

24920 MAGNETISM AND MAGNETIC MATERIALS, 1972. 18th AIP Conference, Denver, Colorado, November 28-December 1, 1972. Graham, C. D. Jr.; Rhyne, J. J. (eds.). New York; American Institute of Physics (1973). 858p. (CONF-721114-P2).

A total of 152 papers and abstracts are presented in this volume, arranged into sections dealing with: tricritical points; critical behavior; whiskers; soft magnetic materials and domains; domain walls; covalency and exchange; rare-earth intermetallics; magnetic tapes; alloys; magnetic compounds; exchange; rare-earth compounds and complexes; rare-earth metals; transition-metal alloys and compounds; transitions and magnetoelectric effect; magneto-optic memory and magnetic recording; organic materials; dead layers; anisotropy and magnetoelastic interactions; magnetic moments and exchange enhancement; and magnetic excitations and spin structures. Separate abstracts have been prepared for 16 of the papers. For abstracts of 6 other papers, see NSA 27: 11214, 11215, 11216, 11217, 13867, and 13868. (DLC)

For abstracts of individual papers see: 25006–25010, 25139–25148, and 25263.

24921 MAGNETISM AND MAGNETIC MATERIALS, 1972. 18th AIP Conference, Denver, Colorado, November 28-December 1, 1972. Graham, C. D. Jr.; Rhyne, J. J. (eds.). New York; American Institute of Physics (1973). 892p. (CONF-721114-P1).

A total of 168 papers and abstracts are presented in this volume, arranged into sections dealing with transition metals and alloys; resonance; magnetic ordering; magnetic resonance in metals, oxides, and fluorides; microwave resonance in materials and devices; bubble devices and materials; bubble-domain properties; soft and hard bubbles; bubbles with complex walls; theory; rare-earth magnets; cobalt–rare earth alloys; neutron scattering and magnetic structure; optical effects; rare-earth magnetoelastic interactions; dilute alloys; and critical behavior. Separate abstracts have been prepared for 25 of the papers. For abstracts of two other papers, see NSA 27: 11219, and 11220. (DLC)

For abstracts of individual papers see: 25011, 25012, 25076–25079, 25149–25166, and 25264.

24922 III INTER-AMERICAN CONFERENCE ON MATERIALS TECHNOLOGY. Conference held at Rio de Janeiro, Brazil, August 14–17, 1972. Buenos Aires; Centro Regional de Ayuda Tecnica (1972). 927p. (In several languages). (CONF-720832-).

A total of 122 papers are presented on materials application in societal technology (housing systems, highway systems, and conventional and nuclear power systems); extractive metallurgy; physical and process metallurgy; polymer science and engineering; and organization, planning, and current practices in materials technology. Separate abstracts were prepared for 15 of the papers; two of the others were previously abstracted as NSA 26: 56746 and 58079. (DLC)

For abstracts of individual papers see: 24142, 24196, 24430, 24923, 24924, 25039, 25062, 25080, 25233, 25234, 26480, 26511, 26657, 26665, and 26796.

24923 MATRIX FATIGUE BEHAVIOR FIBER COMPOSITES SUBJECTED TO REPEATED TENSILE LOADS. Application to B/A1 6061 Composites. Varschavsky, A. (Univ. Chile, Santiago). pp 407-412 of III Interamerican Conference on Materials Technology. Buenos Aires; Centro Regional de Ayuda Tecnica (1972).

From 3rd Inter-American conference on materials technology; Rio de Janeiro, Brazil (14 Aug 1972). See CONF-720832-.

A phenomenological model is developed to evaluate the plastic stress–strain behaviour of a matrix containing fibers. The model is based upon the idealized behavior of the two components of the system. The application of the model to B/A1 alloy composites shows that the plastic stress–strain behavior of the matrix with fibers varies strongly with the fiber volume content, and also that the matrix "in situ" cyclic stress–strain behavior can be approximately described by a power law of the type: $\phi' = \phi_0 (\Delta\epsilon_p'/2)^n$, where the strength coefficient and the exponent increase with the fiber volume fraction. It also predicts that in the steady-state fatigue behavior of the composites, the fraction of load amplitude carried by the fibers decreases with increasing applied stress amplitude and is also dependent on the fiber volume fraction. The effect of the applied stress on the damping capacity is established through expressions derived from the basic ideas involved in the model. (11 figures) (auth)

24924 REINFORCED METALS: MECHANICAL-PROPERTY CONSIDERATIONS. Kershaw, J. P. (Air Force Materials Lab., Wright-Patterson, AFB, OH). pp 437-442 of III Interamerican Conference on Materials Technology. Buenos Aires; Centro Regional de Ayuda Tecnica (1972).

From 3rd Inter-American conference on materials technology; Rio de Janeiro, Brazil (14 Aug 1972). See CONF-720832-.

The search for new high-performance materials to meet the demands of evolving aerospace vehicles has resulted in the development and application of filamentary reinforced metals and polymers. These composite materials are particularly well suited to aerospace applications because of their very desirable mechanical properties (i.e., high weight-normalized strength and stiffness, and high fatigue and creep resistance). The tensile, fatigue, and elevated temperature properties of reinforced metals are discussed. Filament-load angle and filament content considerations are included. A brief discussion of the influence of residual stress and the transverse tensile strength problem are presented. 29 references. (auth)

24925 THEORY AND ANALYTICAL APPLICATIONS OF NUCLEAR QUADRUPOLE RESONANCE SPECTROSCOPY. Brame, E. G. Jr. (E. I. du Pont de Nemours and Co., Wilmington, DE). CRC Crit. Rev. Anal. Chem.; 3: No. 3, 243-270(Aug 1973).

In the last several years NQR has been used uniquely in analytical chemistry. These kinds of applications are covered in this review, following an elementary discussion of the theory involved. Then some of the different kinds of instrumentation that can be employed in examination of materials that give NQR signals is discussed. (1 table, 20 figures, 216 references) (LMT)

Ceramics and Cermets

Refer also to abstracts 24152, 24386, 24622, 25040, 25048, 25205, 26503, 26506, 26508, 26515, 26559, 26560, 26565–26567, 26570, 26571, 26573–26576, 26578–26582, 26584, and 26585.

24926 (AD-756400) GROWTH AND MECHANICAL PROPERTIES OF THE WHISKERS OF BORON AND SOME BORIDES. Ahmad, I. (Watervliet Arsenal, N. Y.). Jun 1968. 81p. (WVT-6820). NTIS.

Whiskers of beta-rhombohedral boron were prepared by heating boron pieces in boron nitride crucibles, both in an inert-gas atmosphere and in vacuum in the temperature range 1850 to 1950°C. The elastic modulus of these whiskers and tensile strengths are discussed. During this work, whiskers of CaB_6, B_4C, and B_2O_3 were also observed to form due to the presence of impurities in BN and in the argon. Whiskers of gamma-TaB also formed as a result of the interaction of BN and the tantalum suscepter used. (NTIS)

24927 (AEC-tr-7463) EQUILIBRIUM DIAGRAMS OF ZIRCONIA-RARE EARTH OXIDES. Lefevre, J.; Perez y Jorba, M.; Collongues, R. Translated from Bull. Soc. Chim. Fr.; 1969-1971 (1959). 7p. Dep. NTIS $3.00.

The systems $ZrO_2-La_2O_3$, $ZrO_2-Nd_2O_3$, $ZrO_2-Gd_2O_3$, and $ZrO_2-Sm_2O_3$ were examined. The following results were obtained: (a) The stability of solid solutions of the trivalent oxide in tetragonal zirconia. Some remarkable properties of these phases were studied. (b) The existence of two types of cubic phases: (1) A nonstoichiometric compound of the pyrochlore type which appears in all investigated systems near the composition $2ZrO_2-M_2O_3$. It is stable up to the melting temperature. The extent of its homogeneity region was determined at different temperatures. (2) A cubic solid solution of the fluorite type which appears in the equilibrium diagram on each side of the pyrochlore phase. The extent of its homogeneity region and its stability depend highly on the nature of the trivalent oxide; for example, the homogeneity of the cubic solid solution $ZrO_2-La_2O_3$ has a eutectoid point; to the contrary, the cubic solid solution $ZrO_2-Nd_2O_3$ is stable up to ordinary temperatures. These results permitted the definition of the equilibrium diagrams. (auth)

24928 (AEC-tr-7469) SELF-DIFFUSION OF URANIUM IN URANIUM DIOXIDE: INFLUENCE OF THE NON-STOICHIOMETRY AND OF GRAIN BOUNDARIES. Marin, J.-F.; Michaud, H.; Contamin, P. Translated from Compt. Rend., Ser. C; 264: 1633-1636(1967). 6p. Dep. NTIS $3.00.

The self-diffusion coefficient of uranium in uranium dioxide was measured at 1500°C in a series of UO_{2+x} specimens which differed from stoichiometry x to varying degrees; the coefficient varies approximately according to a law $D \propto x^2$. Autoradiographic studies demonstrated significant intergranular diffusion for all superstoichiometric specimens. (auth)

24929 (AECL-4452) INTERPRETATION OF CORROSION-PRODUCT PHASES OBSERVED IN U_3Si AFTER IN-REACTOR DEFECT TESTS. Feraday, M. A. (Atomic Energy of Canada Ltd., Chalk River (Ontario). Chalk River Nuclear Labs.). May 1973. 27p. Dep. NTIS (U. S. Sales Only) $3.50. AECL $1.00.

The corrosion-product phases observed in one low-burnup and three high-burnup U_3Si specimens after in-reactor defect tests were identified by comparison with those observed in out-of-reactor tests. Five of the six corrosion product phases observed in the out-of-reactor tests were present in fuel examined after the in-reactor defect tests, i.e., αUSi_2, βUSi_2, USi_3, $U_3Si(H)$ and UO_x. The depth of penetration of hydrogen into U_3Si in high-burnup fuel appeared to be greater than in unirradiated and very low-burnup U_3Si. This deeper penetration is thought to be due to microcracks in the U_3Si. Since the appearance and distribution of the phases in the four specimens examined were fairly consistent, identification of phases in future defect tests should be facilitated. (auth)

24930 (ANL-7929(Suppl.1)) ACTINIDE REDISTRIBUTION IN MIXED-OXIDE FUELS IRRADIATED IN A FAST FLUX. Meyer, R. O.; Butler, E. M.; O'Boyle, D. R. (Argonne National Lab., Ill.). Jul 1973. Contract W-31-109-eng-38. 7p. Dep. NTIS $4.00.

Measurements of uranium and plutonium concentrations obtained with an electron-microprobe analyzer are presented for two EBR-II-irradiated fuel elements fabricated with low oxygen-to-metal ratios. The data exhibit a small, but significant, decrease in plutonium concentration near the central void in contrast to results from nearly stoichiometric fuels. These hypostoichiometric fuels were not previously available for examination, and the present data are intended to supplement results presented in an earlier report by the same authors (ANL-7929). (auth)

24931 (BNWL-65) SUBMICRON DISPERSION OF UO_2 IN TUNGSTEN. Bowersock, R. V.; Last, G. A. (Battelle Northwest, Richland, Wash. Pacific Northwest Lab.). Aug 1965. Contract AT(45-1)-1830. 57p. (NASA-CR-54318). Dep. NTIS $5.00.

Declassified 9 Apr 1973.

An experimental program was conducted to determine the feasibility of producing a submicron dispersion of UO_2 in tungsten by coprecipitation. Feasibility was established; however, difficulties were encountered in maintaining the submicron particle size since subsequent thermal treatments caused coalescence of the UO_2 particles to a larger (2 to 5 μ) size. Although the process developed appears capable of producing any desired fuel loading, only powders having 10, 20, and 30 vol % UO_2 were evaluated. Minimal work was done in the fabrication of powder into usable metallic products. (auth)

24932 (CEA-R-4465) METALLURGY AND THERMODYNAMICS OF A CARBIDE FUEL CONTAINING INACTIVE FISSION PRODUCTS: SIMULATION OF IRRADIATED NUCLEAR FUEL. Lorenzelli, N. (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'etudes Nucleaires). Jul 1973. 126p. (In French). Dep. NTIS (U. S. Sales Only) $8.50.

Thesis. Submitted to Paris Univ., Orsay, France.

This report brings up to date and complements the present literature knowledge on the various systems: uranium carbide–fission products (UC–F.P.), in particular UC–R.E. (rare earths), UC–Mo, UC–Ru, UC–Pd. It deals then with a "simulated" fuel, either partially or totally, i.e., without or with volatile F.P.; the fabrication process is described as well as the metallurgy and the thermodynamic properties of these materials, with emphasis on the effect of burnup on the variation of the parameter of the lattice and on the existence of the various phases to be formed. Three irradiation burnups were simulated: 70,000; 100,000; and 150,000 MWd/t (U + Pu). An analysis was performed on the chemical behavior of the fuel during irradiation, in presence of the stainless steel cladding. Several conclusions of technological interest could be derived, in particular, the noncarburizing character of the fission process. Finally, some irradiation results are discussed. (2 tables, 37 figures, 47 references) (auth)

24933 (EUR-4954, pp 167-172) ORDER–DISORDER TRANSFORMATION OF INTERSTITIAL DEUTERIUM ATOMS IN THE Ta–D SYSTEM. Asano, H.; Yamaguchi, S.; Hirabayashi, M.; Watanabe, N.; Niimura, N.; Yamada, Y.; Kimura, M. (Tohoku Univ., Sendai). Apr 1973.

From joint meeting on pulsed neutrons and their utilization; Ispra, Italy (17 Sep 1971).

The arrangements of deuterium atoms in $TaD_{0.72}$ is proposed from neutron-diffraction data taken by the TOF method at three different temperatures. In the diffraction patterns obtained at 80 and 130°C, the superlattice reflections observed at 20°C vanish and only the fundamental reflections remained. By the use of this method, the diffraction patterns were obtained with higher resolution and with large number of reflections of higher index. (EU)

24934 (HEDL-SA-565) BORON CARBIDE DEVELOPMENT FOR FFTF CONTROL ELEMENTS. Dahl, R. E. Jr. (Hanford Engineering Development Lab., Richland, Wash.). Apr 1973. Contract AT(45-1)-2170. 27p. Dep. NTIS $3.50.

The effort undertaken to provide boron carbide for FFTF control elements is described. Emphasis is placed on experimental results dealing with irradiation effects that affect control-element performance and design. Results are presented for gas release, swelling, compatibility, and thermal conductivity for burnup levels up to 15×10^{20} captures/cm^3 of B_4C. (auth)

24935 (IS-T-603) NUCLEAR MAGNETIC RESONANCE STUDY OF THE VANADIUM, NIOBIUM, AND TANTALUM DEUTERIDES. Roenker, K. P. (Ames Lab., Iowa). Sep 1973. Contract W-7405-eng-82. 147p. Dep. NTIS $9.50.

Thesis.

Self-diffusion of interstitial deuterium in the transition metal deuterides VD_x, NbD_x, and TaD_x with $0.2 \leq x \leq 0.9$ was studied in the temperature range 4.2 to 450°K by nuclear magnetic resonance in polycrystalline (powdered) specimens. A narrow (<10e), single-line, ^2D resonance was observed in the NbD_x and TaD_x samples above a critical temperature T_c. Below T_c, a spin-one electric quadrupole split resonance was found. The critical temperature (~400°K for NbD_x and ~350°K for TaD_x) varied with the deuterium concentration, in good agreement with the reported $\alpha' + \beta \longrightarrow \alpha'$ and $\alpha + \beta \longrightarrow \alpha$ phase boundaries, respectively. At the same $\alpha' + \beta \longrightarrow \alpha'$ phase boundary, the ^{93}Nb resonance in the deuteride underwent an acute change in intensity. The marked reduction in intensity accompanying the formation of the β phase was attributed to quadrupole broadening of the resonance by the change from bcc to fcc. As the deuterium concentration in the deuteride increased, the ^{93}Nb Knight shift decreased. The ^{181}Ta resonance in the deuteride, however, was not observable under any conditions. In the vanadium deuterides, two quadrupole-split ^2D spectra, each with a different critical temperature, were observed. The smaller ν_Q spectrum was present only in the higher concentration samples (D/V > 0.5) and only in the low temperature (T < 220°K), δ phase. This spectrum and phase were very similar to the quadrupole-split spectrum and the β phase of NbD_x and TaD_x. In the β phase of VD_x, the occupancy of octahedral sites by the deuterium atoms was the surmised origin of the ν_Q = 110 kHz spectrum. In contrast with the ^{93}Nb resonance, no marked change in the ^{51}V intensity in the deuteride at the critical temperature was noted. Very likely, the smaller quadrupole moment of the ^{51}V nucleus accounted for this difference. The ^{51}V Knight shift was found to have a deuterium concentration dependence similar to that of the ^{93}Nb resonance. Correlation of the results with published NMR, neutron diffraction, and other results led to the following conclusions: The absence of any significant change in the quadrupole coupling parameters of the ^2D spectrum in NbD_x and TaD_x and the $\eta \sim 0.10$, ν_Q = 59 kHz spectrum in VD_x from T_c down to 4.2°K indicates that this quadrupole interaction is independent of the deuterium atom diffusion rate. The z axis of the principal axes system of the electric field gradient (EFG) should lie along the crystallographic c axis, and the motion of the deuterium atoms below the critical temperature should be restricted to the plane perpendicular to the c axis. (53 figures, 14 tables, 83 references) (DLC)

24936 (JPRS-59863) ABSORBING MATERIALS AND CONTROL RODS FOR FAST REACTORS. 1973. Translation of Papers Presented at the Meeting of the International Working Group for Fast Reactors, Dimitrovgrad, USSR, 4-8 June 1973. (CONF-730652-). 106p. NTIS.

From meeting of the international working group for fast reactors; Dimitrovgard, USSR (4 Jun 1973).

Information on neutron absorbing materials is presented in papers concerning boron carbide properties, performance of BOR-60 reactor control rods, BN-50 reactor control units, absorber rods for fast reactors, rare earth absorbers, performance of SUZ control and safety rods, structure of high-purity boron carbides, control rods for Na-cooled fast reactors, and testing control elements in BR-5 reactor. (JRD)

24937 (LA-3361) TESTING PYROLYTIC CARBON-COATED UO_2 PARTICLES. Kerrisk, J. F.; Hoffman, C. G. (Los Alamos Scientific Lab., N. Mex.). 1 Jun 1965. Contract W-7405-eng-36. 21p. Dep. NTIS $3.25.

Declassified 28 Aug 1973.

A series of samples of UO_2 particles coated with pyrolytic carbon was examined as a possible means of loading uranium into Rover fuel elements. The samples were tested both as loose particles and incorporated into an extruded graphite matrix. None of the samples would be usable in a fuel element which is required to

operate above 2500°C. The particles fail due to internal CO pressure generated by the reaction of UO_2 and carbon. (10 figures, 5 tables) (auth)

24938 (LA-3513) METALLOGRAPHIC PREPARATION TECHNIQUES FOR MULTIPLE METAL CARBIDE COATINGS. Bender, J. H. (Los Alamos Scientific Lab., N. Mex.). 10 May 1966. Contract W-7405-eng-36. 10p. Dep. NTIS $3.00.

Declassified 28 Aug 1973.

Metallographic preparation techniques were developed for multi-layer coatings on graphite, i.e., Mo over NbC on a graphite matrix that also converts to Mo_2C and Mo over NbC and Nb_2C on graphite after hot-gas-testing the element. Grinding of the samples is accomplished with SiC grits, followed by an impregnation step, a light regrinding, and polishing with diamond on automatic rotary wheels. Etching is conventional chemical and/or electrolytic etching followed by a cathodic vacuum etch. (auth)

24939 (LA-3601) DEVELOPMENT OF PARTICLES COATED WITH PYROLYTIC CARBON. II. Coatings from Methane at High Temperatures. Bard, R. J.; McCreary, W. J.; Baxman, H. R.; Bertino, J. P.; O'Rourke, J. A.; Hayter, S. W.; Savage, A. W. Jr.; Tinkle, M. C. (Los Alamos Scientific Lab., N. Mex.). Jul 1966. Contract W-7405-eng-36. 50p. Dep. NTIS $4.50.

Declassified 29 Aug 1973.

The preparation of particles coated with pyrolytic carbon from methane at high temperatures was studied on a laboratory scale in attempts to develop improved coated particles for potential use in Rover graphite-matrix fuel elements. The influence of the conditions of deposition and properties of the pyrolytic-carbon coatings and the influence of the type of UC_2 cores on the stability of the coated particles at 2300°C and higher temperatures were determined. Pyrolytic carbon coatings were deposited at well-defined temperatures of 1700, 2000, and 2300°C on fluidized beds of UC_2 particles from methane–helium mixtures in a 1-in.-dia graphite coater with an uncooled gas inlet. At 1700 and 2000°C coatings were deposited on both carbon-bed UC_2 particles with a precoat of low-temperature pyrolytic carbon and General Atomic UC_2 particles with a continuous graphite shell. At these temperatures coating of the General Atomic cores had to be done at initial rates higher than about 10 μ/hr to prevent extensive damage to the graphite shell on many of the particles. Coating at 2300°C had to be done over thick precoats of high-density pyrolytic carbon to avoid migration into the 2300°C layer during deposition. At 1700°C high-density laminar coatings were obtained at very low deposition rates, high-density granular coatings were obtained at intermediate rates, and low-density isotropic coatings were obtained at high rates. The laminar and granular 1700°C coatings as overlays on precoated carbon-bed UC_2 particles resisted migration at 2300°C, but the isotropic coatings did not. Coatings deposited at 2000°C over a wide range of rates had densities of 2.15 ± 0.02 g/cm^3 and, as overlays on precoated carbon-bed UC_2 particles, resisted migration at 2300°C. None of the particles with 1700 or 2000°C coatings on precoated carbon-bed UC_2 cores, nor the particles with 2300°C coatings, survived heating at 2500°C for 30 min. Particles with 2000°C coatings on General Atomic UC_2 cores had a lower incidence of survival at 2500°C than particles with low-temperature (1200 to 1400°C) coatings on General Atomic cores, presumably due to slight damage to the graphite shell on the cores during coating at high temperature. (auth)

24940 (LA-3767) DEVELOPMENT OF PARTICLES COATED WITH PYROLYTIC CARBON. IV. Coatings from Various Hydrocarbons at Low Temperatures. Bard, R. J.; Savage, A. W. Jr.; Baxman, H. R.; McCreary, W. J.; Bertino, J. P.; Hayter, S. W.; O'Rourke, J. A. (Los Alamos Scientific Lab., N. Mex.). Jul 1967. Contract W-7405-eng-36. 37p. Dep. NTIS $4.00.

Declassified 29 Aug 1973.

Particles with UC_2 cores and pyrolytic carbon coatings deposited from various hydrocarbon–helium mixtures at low temperatures were prepared on a laboratory scale in attempts to develop improved coated particles for use in Rover graphite-matrix fuel elements. Coatings were deposited in fluidized beds from ethane and propane at 1200, 1300, and 1400°C; from benzene at 1100 and 1200°C; and from cyclohexane at 1200°C. The properties and resistance to migration at 2300 and 2500°C were determined and compared with those of coatings prepared previously from methane and acetylene. The coatings deposited from various hydrocarbon–helium mixtures at a given temperature showed the same general trends of microstructure or density with deposition rate, indicating that the general deposition mechanisms were relatively independent of the carbon source. At a deposition temperature of 1400°C, the trend of microstructures was from columnar to laminar to isotropic, and plots of coating density vs deposition rate showed density minima at intermediate rates. At 1300 and 1200°C, the trend of microstructures was from laminar to isotropic. The densities of the 1200°C laminar coatings increased regularly with deposition rate to apparent limiting values of 2.0 to 2.1 g/cm^3. All of the 1400°C coatings had very poor resistance to migration at 2300°C. At 1300°C, methane–helium mixtures yielded some coatings that had better resistance to migration at 2300°C than any of those prepared from ethane, propane, or acetylene. For 1200°C coatings the resistance to migration at 2300°C appeared to peak for all of the hydrocarbons except benzene at initial coating rates near 10 μ/hr and densities of 1.9 to 2.0 g/cm^3. A set of coatings prepared under these conditions from seven different hydrocarbons (methane, ethane, ethylene, acetylene, propane, cyclohexane, and benzene) all had very similar microstructures (laminar), high preferred orientation indexes (M ≥ 7), high densities (1.9 to 2.0 g/cm^3), small apparent crystallite sizes (L_c = 28 to 40A), and interplanar spacings characteristic of turbostatic carbon (d_{002} = 3.45 to 3.46 A). Only the coating from benzene failed to show corresponding good resistance to migration at 2300°C. None of the particles with nominal 25-μ-thick coatings on carbon-bed UC_2 cores survived heating at 2500°C for 30 min. None of the coatings from the other hydrocarbons had any apparent advantage over the best of those from methane with respect to resistance to migration at 2300°C. (auth)

24941 (LA-3984) DEVELOPMENT OF PARTICLES COATED WITH PYROLYTIC CARBON. V. Doped Coatings. Bard, R. J.; Baxman, H. R.; O'Rourke, J. A.; McCreary, W. J.; Savage, A. W. Jr.; Bertino, J. P. (Los Alamos Scientific Lab., N. Mex.). Jun 1968. Contract W-7405-eng-36. 30p. Dep. NTIS $3.50.

Declassified 29 Aug 1973.

Attempts were made to improve the stability of pyrolytic-carbon-coated UC_2 particles at 2500°C, by codepositing ZrC or UC_2 in the coatings or using aluminum or iron as a graphitization catalyst in efforts to prepare more graphitic or graphitizable coatings. Pyrolytic-carbon coatings were deposited at 2000°C with $ZrCl_4$, UF_4, $AlCl_3$, or $FeCl_3$ added to methane–helium mixtures, and at 1200°C with $FeCl_3$ or $Fe(CO)_5$ added to acetylene–helium mixtures. None of the as-deposited, doped pyrolytic carbons examined by x-ray diffraction was more graphitic than the corresponding control but, in many cases, the graphitizability of the coatings at 2300°C was increased. This did not improve the resistance of the coatings to the accumulation or migration of UC_2 from the core, however; on the contrary, the resistance at 2300°C of coatings containing codeposited ZrC or UC_2 was poorer than that of the control, presumably due to the development of microporosity during graphitization of at least part of the pyrolytic carbon. In no case was an improvement of the stability of the coated particles at 2500°C obtained, whether the particles were heated to 2500°C directly or after pretreatment at temperatures up to 2300°C and cooling. (auth)

24942 (LA-4139) DEVELOPMENT OF PARTICLES COATED WITH PYROLYTIC CARBON. VI. Comparisons of Experimental UC_2 Cores. Bard, R. J.; Lyon, L. L.; Baxman, H. R.; Bertino, J. P.; Hayter, S. W.; McCreary, W. J. (Los Alamos Scientific Lab., N. Mex.). Feb 1969. Contract W-7405-eng-36. 23p. Dep. NTIS $3.25.

Declassified 28 Aug 1973.

Attempts were made to obtain UC_2 cores with improved graphite shells for use in a program to develop pyrolytic-carbon-coated particles with good stability at 2500°C in fuel elements for Rover reactors. A large number of small batches of experimental UC_2 cores prepared under various conditions were purchased from General Atomic. Various fractions from six batches, which had adequate sphericity and covered a wide range of carbon contents, were coated, evaluated, and compared. The carbon contents ranged from 9.3 to 13.3 wt % in the 124- to 208-μ-dia fraction. Cores of this fraction with 11.1 wt % carbon had the lowest incidence of damage (50 to 60%) in particles with nominal 100-μ-thick pyrolytic carbon coatings after heating at 2500°C for 30 min. The conditions of preparation of this pilot batch were chosen for the manufacture of a 4-kg batch of experimental General Atomic UC_2 cores. Various fractions of the pilot batch were coated in several ways and compared. Indications were obtained that the penetration of the coatings by melt at 2500°C was determined not only by the incidence of core damage and the resistance of the coating but also by the extent of damage to the graphite shells on individual cores. Properties of the cores and corresponding coated particles from the pilot batch and the 4-kg batch were very similar. For particles with nominal 25-μ-thick coatings on cores from the six small experimental batches and the 4-kg batch, the percentage of uranium exposed to leaching after heating at 2300°C for 4 h, cooling, and heating at 2500°C for 30 min was not less than 20% in any case. (auth)

24943 (LA-4226) DEVEOPMENT OF PARTICLES COATED WITH PYROLYTIC CARBON. VII. Studies of Porous Carbon. Bard, R. J.; Baxman, H. R.; McCreary, W. J.; Hayter, S. W.; Bertino, J. P.; O'Rourke, J. A.; Savage, A. W. Jr. (Los Alamos

Scientific Lab., N. Mex.). Jul 1969. Contract W-7405-eng-36. 31p. Dep. NTIS $3.75.

Declassified 28 Aug 1973.

Porous carbon was studied for use as an inner sacrificial layer in two-layer, pyrolytic-carbon coatings on UC_2, in attempts to develop particles with improved stability at 2500 or 2600°C for use in fuel elements for Rover reactors. Four types of migration-resistant pyrolytic carbons were characterized for use as the outer layer. Particles with the various two-layer coatings on carbon-bed UC_2 cores and on proprietary UC_2 cores with a complete graphite shell were prepared and tested. Only the particles with the proprietary cores had nominal stabilities when the total coating thickness was about 50 μ, as required of particles having useful uranium contents. The best particles in the useful category had no more than 3% of the total uranium exposed by heating for 30 min at 2500 or 2600°C after pretreatment at 2300°C for 4 h to reorganize the outer layer of pyrolytic carbon and subsequent cooling. However, ways were not found to obtain particles in good yield with the required 15- to 25-μ-thick porous layer having good uniformity of thickness from particle to particle. (auth)

24944 (LA-4560) DEVELOPMENT OF PARTICLES COATED WITH PYROLYTIC CARBON. IX. Studies of Commercial Experimental Coated Particles. Baxman, H. R.; Bertino, J. P.; Bard, R. J.; Hayter, S. W.; O'Rourke, J. A.; Levinson, L. S. (Los Alamos Scientific Lab., N. Mex.). Nov 1970. Contract W-7405-eng-36. 23p. Dep. NTIS $3.25.

Declassified 29 Aug 1973.

Attempts made to obtain kilogram quantities of improved particles having proprietary UC_2 cores with a complete graphite shell and having pyrolytic carbon coatings are described. Particles with single- and two-layer coatings were purchased for use in developmental Rover fuel elements. The experimental particles coated in production equipment were substantially less stable at 2500°C and higher temperatures than control particles with the same cores coated in 1-in.-dia equipment. The high-density, oriented pyrolytic carbon deposited having a smooth microstructure was proved to be more resistant to penetration by melt than the high-density, oriented pyrolytic carbon commercially deposited having an "onion-ring" type of microstructure. Results of electron microscopy indicated that the deficiencies of the commercial coating were due to incorporated soot that blocked densification of the coating during pretreatment of the particles and led to persistent disordered regions with poor resistance to penetration by melt. (auth)

24945 (LA-4771) DEVELOPMENT OF PARTICLES COATED WITH PYROLYTIC CARBON. X. Scale-up of Coating Processes. McCreary, W. J.; Baxman, H. R.; Bard, R. J.; Bertino, J. P.; O'Rourke, J. A.; Hayter, S. W. (Los Alamos Scientific Lab., N. Mex.). Apr 1972. Contract W-7405-eng-36. 26p. Dep. NTIS $3.50.

Declassified 29 Aug 1973.

A 3-in.-dia, fluidized-bed coater was developed for the deposition of high-density, oriented pyrolytic carbon having a smooth microstructure. Such a coating is required as an outer layer for good retention of melt above 2450°C in improved UC_2 particles with a complete graphite shell and an inner, sacrificial layer of high-density, isotropic pyrolytic carbon. The coater has a baffle system consisting of a $\frac{1}{2}$-in.-wide lip at the top of the coating chamber and a $3\frac{1}{2}$-in.-dia plate above the lip to confine the fluidized bed so that high flow rates of the coating gas mixture can be used. The reduced resistance time of the gas at high flow rates prevents soot particles from forming in the coating chamber and becoming incorporated into the coating. About 5 kg U of improved coated particles with the outer layer deposited in this coater on the 575-g-U scale were prepared for use in Rover experimental graphite-matrix fuel elements. The thermal stability of these particles was very comparable with that of control particles coated in 1-in.-dia equipment. The amounts of uranium exposed in tests of the particles following pretreatment at 2300°C for 4 h and cooling were: <1% for 30 min at 2500°C, <3% for 30 min at 2600°C, and about 20% for three 30-min cycles at 2500 or 2600°C. Pretreatment at 2200°C for 4 h or at 2400°C for 3 h was equally effective. Sixty 10-min cycles at 2300 or 2400°C, following pretreatment at 2300°C for 4 h and cooling, exposed <0.1 or <0.2%, respectively, of the uranium in the particles. (auth)

24946 (LA-5247) ETCHANT FOR $(U,Pu)O_2$ IRRADIATED FUEL AND IRRADIATED CLADDING. Bender, J. H.; Baker, C.; Johnson, K. A. (Los Alamos Scientific Lab., N. Mex.). Jul 1973. Contract W-7405-eng-36. 5p. Dep. NTIS $4.00.

A new chemical etchant is described for experimental fast-breeder-reactor fuels including irradiated $(U,Pu)O_2$, 304 and 316 stainless steel, and Incoloy 800. The etching techniques and characteristics of the etching solution (10 HCl, 10 HBr, 1 HF) are also reported. (auth)

24947 (LA-5320-MS) HYDROGEN ABSORPTION BY AB_5 COMPOUNDS. Anderson, J. L.; Wallace, T. C.; Bowman, A. L.; Radosevich, C. L.; Courtney, M. L. (Los Alamos Scientific Lab., N. Mex.). Jul 1973. Contract W-7405-eng-36. 8p. Dep. NTIS $4.00.

Hydrogen absorption–desorption by the intermetallic AB_5 compounds, where A = a rare earth and B = cobalt or nickel, is studied. These compounds will readily absorb large quantities of hydrogen at ambient temperature and at pressures only slightly above the equilibrium dissociation pressures. When the hydrogen pressure over these hydrides is reduced below the dissociation pressure the hydrogen is rapidly and quantitatively desorbed. It is shown that the dissociation pressure for the AB_5 compounds increase as A changes across the lanthanide series (La→Gd). The total amount of hydrogen absorbed decreases as A is changed across the series. The nickel compounds generally absorb more hydrogen than the cobalt analog but the cobalt compounds have a lower dissociation pressure. By selectively changing A and B, hydrides with dissociation pressures from ~1.5 atm to ~130 atm can be synthesized. These compounds show considerable promise for use in the storage, transport, and pumping of hydrogen. (auth)

24948 (ORNL-TM-4312) COMPATIBILITY OF CALCIUM-SILICATE INSULATING BOARD (JOHNS-MANVILLE PRODUCT HEAT-TREATED MARIMET-45) WITH ENGINEERING ALLOYS AT 1100 TO 1600°F. Huntley, W. R.; Koger, J. W. (Oak Ridge National Lab., Tenn.). Sep 1973. Contract W-7405-eng-26. 27p. Dep. NTIS $3.50.

Calcium-silicate insulating board (Johns-Manville product "heat-treated Marimet-45") was tested as a candidate material for spacer bushings which support electric clamshell heaters on high-temperature piping systems. Compatibility tests were made in typical piping configurations at temperatures from 1100 to 1600°F. No detrimental effects were observed on three metal alloys after 5700 h exposure to calcium silicate at high temperature. It was concluded that the test material is suitable for use as support spacers for clamshell heaters. The material appears useful for other applications where a readily machinable, load-bearing, electrical or thermal insulation must be in contact with the high-temperature alloys tested. The oxidation characteristics of the three alloys were noted at various positions along the tubes. Hastelloy N showed the most oxidation resistance, followed by type 316 stainless, with type 304 stainless steel showing the least. (auth)

24949 (RISO-274) METALLURGY DEPARTMENT PROGRESS REPORT, 1 APRIL 1971–31 DECEMBER 1972. (Danish Atomic Energy Commission, Risoe. Research Establishment). Mar 1973. 46p. Dep. NTIS (U.S. Sales Only) $4.50.

Research and development activities during the period are reviewed. Information is included on single-phase and two-phase materials, Zr alloys, brazing, nondestructive testing, irradiation of Zircaloy-clad UO_2 fuels, microscopy of deformed MgO, and international research participation. (JRD)

24950 (SC-DC-67-1412-A) ERBIUM–DEUTERIUM SYSTEM. Final Report. Lundin, C. E. (Denver Research Inst., Colo.). 15 May 1967. Contract 16-4115. 22p. Dep. NTIS $3.25.

For Sandia Corp., Albuquerque, N. Mex.

The character of the erbium–deuterium system was established from pressure–temperature–composition relationships. A Sievert's apparatus was used to make measurements in the temperature range, 473 to 1223°K, the composition range of Er to ErD_3, and the pressure range of 10^{-5} to 760 torr. The system is characterized by three homogeneous phase regions: the metal-rich, the dideuteride, and the trideuteride phases. These phases and their solubility boundaries were deduced from the family of isotherms of the system which relate the pressure–temperature–composition variables. The equilibrium plateau decomposition relationships in the two phase regions were determined from van't Hoff plots to be: $Er_{ss} + ErD_2$; $\log_{10}P$ (torr) = $-$ (1,570 ± 40/T) + 10.81 ± 0.04; and, $ErD_2 + ErD_3$; $\log_{10}p$ (torr) = $-$ (4380 ± 30/T) + 9.66 ± 0.05. The differential heats of reaction in these two regions are, $\Delta H = -53.0 \pm 0.2$ kcal/mole of D_2 and $\Delta H = -20.0 \pm 0.1$ kcal/mole of D_2, respectively. The differential entropies of reaction are $\Delta S = -36.3 \pm 0.2$ cal/mole $D_2 \cdot$ deg and $\Delta S = -31.0 \pm 0.2$ cal/mole $D_2 \cdot$ deg, respectively. Relative partial molal and integral thermodynamic quantities were calculated from the pure metal to the dideuteride phase. (auth)

24951 (TID-26401) POST-IRRADIATION EXAMINATION OF NpO_2–ZrO_2 TARGET RODS. Interim Progress Report. Lowry, L. M.; Farmelo, D. R. (Battelle Memorial Inst., Columbus, Ohio). 14 Jun 1973. Contract AT(29-2)-2652. 31p. Dep. NTIS $3.75.

Activities are reported in programs to fabricate and irradiate Np-fueled target rods to determine the ^{238}Pu yield in compositions of NpO_2–ZrO_2. Information is included on target rod fabrication,

target rod recovery, visual examination, gamma scanning, cover gas analysis, target rod disassembly, metallographic examinations, chemical analyses, microprobe analyses, and neutron dosimetry. (JRD)

24952 METALLIDY: STROENIE: SVOISTVA: PRIMENENIE. (Metallides: Structure, Properties, and Application). Kornilov, I. I.; Matveeva, N. M. (eds.). Moscow; Izdatel'stvo Nauka (1971). 168p.

The 21 articles of this publication are devoted to chemical bonds, crystal structure, and physico-chemical and thermodynamic properties, as well as practical applications of the basic classes of metallides (intermetallics, carbides, nitrides, suboxides, phosphides, and other compounds). Constitution diagrams and aspects of chemical interactions of many metallides are examined. For most systems, the present status and outlook is presented for metallides of established classes (e.g., magnesium compounds, aluminides, arsenides, chalcogenides, etc.). A separate abstract was prepared for each of the 9 articles in scope for NSA. (LMT)

For abstracts of individual sections see: 24953–24959, 25092, and 25093.

24953 NEUTRONOGRAPHIC INVESTIGATION OF ORDERING IN SUBOXIDES OF TITANIUM AND ZIRCONIUM. Fykin, L. E.; Ozerov, R. P.; Smirnov, V. P.; Solov'ev, S. P.; Sumin, V. V. pp 80-87 of Metallidy: Stroenie, Svoistva, Primenenie. Kornilov, I. I. (ed.). Moscow; Izdatel'stvo Nauka (1971). (In Russian)

The suboxides in the binary system titanium–oxygen and zirconium–oxygen and the ternary system titanium–zirconium–oxygen were studied. X-ray structure analysis and neutronography were used. It was shown that the presence of oxygen can show significant effect on the structure and properties of metals and alloys, in which it is dissolved by means of the formation of a complete series of a suboxide phase with ordered arrangement of the oxygen atoms. It was established that, in the systems studied, the degree of ordering of the atoms increases with increase of the oxygen content. In the ternary system titanium–zirconium–oxygen, the existence of a new suboxide with the composition Ti_2ZrO with an order structure comparable to the hexagonal system was detected. (tr-auth)

24954 INVESTIGATION OF SOLID SOLUTIONS OF OXYGEN IN TITANIUM AND ZIRCONIUM AND SOME TERNARY ALLOYS OF THE SYSTEM Ti-Zr-O. Model, M. S.; Shubina, G. Yu. pp 88-95 of Metallidy: Stroenie, Svoistva, Primenenie. Kornilov, I. I. (ed.). Moscow; Izdatel'stvo Nauka (1971). (In Russian)

As a result of microscopic and x-ray investigations of the structure and properties of solid solutions of oxygen in Ti and Zr (hardness, electrical resistance, thermoelectromotive force, thermal expansion, modulus of elasticity), it is shown that the formation of ordered solid solutions, on the basis of Ti_2O, clearly is fixed in alloys with 25 to 33 at. % oxygen content in α-Ti and alloys having the substructure Ti_3O (stable below 500°) and is indicated with singularities in isothermal properties. The value of the coefficient of thermal expansion of the alloy Ti–O showed that the ordering in this system does not lead to significant change of the crystal lattice energy, with which the value of the modulus of elasticity of the alloy Ti_3O agreed. In the ranges of solubility of oxygen in α-Ti (up to 35 at. %) and in α-Zr (up to 29 at. %), the two-phase fields (mixture of ordered and unordered solid solution) were not detected; for according to the x-ray data in general, amounts greater than 1 to 2 at. % were excluded. The absence of a singular point on the isotherm of the electrical resistance for the suboxide Zr_3O was examined in relation to the character of formation of the ordered solid solution. It was confirmed that the anomalous character of the dependence of the electrical resistance on temperature for Ti–O and Zr–O is not associated with the formation of hyperstructure. The generality of this anomaly for alloys of both systems, together with the analogy to the change of the electromotive force, indicates the nearness of the chemical nature of the ordered Ti–O and Zr–O alloys. It was established that the Ti_3O–Zr_3O profile of the Ti–Zr–O system, intersecting the region of existence of the ternary phase X, separated from Ti_3O and Zr_3O with the two-phase fields, does not appear quasibinary. On the basis of a comparison of the results obtained with the literature data, conclusions were drawn on the structure of high-grade Ti and Zr and properties of the ordered solid solutions of oxygen in Ti and Zr. (tr-auth)

24955 INTERACTION BETWEEN SUBOXIDES OF TITANIUM AND ZIRCONIUM AND TITANIUM STANNIDES. Vavilova, V. V.; Kenina, E. M.; Kornilov, I. I. pp 96-98 of Metallidy: Stroenie, Svoistva, Primenenie. Kornilov, I. I. (ed.). Moscow; Izdatel'stvo Nauka (1971). (In Russian)

By physical chemical methods of analysis, it was established that the systems Ti_3O–Zr_3O, Ti_3–Ti_3Sn, and Zr_3O–Ti_3Sn are characterized by the eutectic types of interaction. In the system Ti_3O–Zr_3O, the compound Ti_2ZrO was detected and in the system Zr_3O–Ti_3Sn, the compound $(Ti,Zr)_5Sn_3$ was detected. (tr-auth)

24956 SINGULARITIES OF CRYSTALLINE STRUCTURE AND CHEMICAL BONDS IN THE SYSTEM Ta-O. Khitrova, V. I.; Klechkovskaya, V. V. pp 98-105 of Metallidy: Stroenie, Svoistva, Primenenie. Kornilov, I. I. (ed.). Moscow; Izdatel'stvo Nauka (1971). (In Russian)

On the basis of structural electronographic analysis, it was shown that in the tantalum oxide system at the boundary of each phase, significant variation of the composition, interatomic distance, and chemical bonds is possible. Most are characterized in this relation of tantalum dioxide with the general formula TaO_{2-x}, where $0 < x < 1$. In the system studied, the phases were fixed both with stoichiometric composition and with deviation because of the appearance of defects in the oxide or metallic sublattice, or in both simultaneously. It was shown that during oxidation of tantalum, friable structures with labile framework are formed preferentially. (tr-auth)

24957 MODULUS OF ELASTICITY OF REFRACTORY NITRIDES, CARBIDES, AND BORIDES. Portnoi, K. I.; Mukoseev, A. A.; Gribov, V. N.; Levinskii, Yu. V.; Prokof'ev, S. A. pp 123-126 of Metallidy: Stroenie, Svoistva, Primenenie. Kornilov, I. I. (ed.). Moscow; Izdatel'stvo Nauka (1971). (In Russian)

The dynamic modulus of elasticity of some refractory nitrides, carbides, and borides obtained by the method of diffusion saturation was measured. The following values were obtained (in kg/mm^2): $E_{TiN} = 61{,}600 \pm 2{,}000$, $E_{NbN} = 49{,}300 \pm 2{,}000$, $E_{NbC} = 58{,}000 \pm 2{,}000$, $E_{TaB_2} = 70{,}000 \pm 2{,}000$, $E_{W_2B_5} = 79{,}000 \pm 2{,}000$, $E_{ZrN} = 51{,}000 \pm 2{,}000$, $E_{TaN} = 58{,}700 \pm 2{,}000$, $E_{NbB_2} = 65{,}000 \pm 2{,}000$, and $E_{Mo_2B_5} = 68{,}500 \pm 2{,}000$. From the experimental value of the modulus of elasticity, the magnitudes of the characteristic temperatures of the refractory compounds were calculated. (tr-auth)

24958 SOME REGULARITIES IN EVAPORATION OF CARBIDES OF TRANSITION METALS OF SUBGROUPS IV TO V IN A VACUUM. Nikol'skaya, T. A.; Avarbe, R. G. pp 127-134 of Metallidy: Stroenie, Svoistva, Primenenie. Kornilov, I. I. (ed.). Moscow; Izdatel'stvo Nauka (1971). (In Russian)

By the Langmuir method, the process of evaporation of the carbide phase of Nb, Ta, Zr, and Hf was investigated in a vacuum of 1×10^{-5} mm Hg. The congruent character of the evaporation of the monocarbide phase of Nb, Zr, and Hf and the polycarbide phases of Ta were established. The temperature dependence of the congruently evaporating compounds and the rates of the congruent evaporation of the above-mentioned carbide phase were found in a wide temperature interval. Equations were proposed for the temperature and concentration dependences of the thermodynamic functions (a_C, a_{Me}, $\Delta^{Z}_{f,T}$, $\Delta H^{0}_{f,T}$, $\Delta S^{0}_{f,T}$) of the penetration phase of NbC_n and ZrC_n. Under the assumption of the uniformity of the composition of the phases in connection with its very insignificant change during congruent evaporation according to the second and third law of thermodynamics, the heats of evaporation and formation of HfC and Ta_2C were calculated in good agreement with literature data. (tr-auth)

24959 ELECTRICAL RESISTANCE AND MAGNETIC SUSCEPTIBILITY OF TRANSITION-METAL HYDRIDES. Nemchenko, V. F. pp 149-157 of Metallidy: Stroenie, Svoistva, Primenenie. Kornilov, I. I. (ed.). Moscow; Izdatel'stvo Nauka (1971). (In Russian)

Questions on the position of the atoms of hydrogen, particularly their electrons, in the lattice of d-transition metals were examined. The analysis of the capacity of the metals for the dissolution of hydrogen indicates the development of conditions of solubility with increase of the defects of the d-state and the relation r_d/r_n (where r_d is the effective radius of the d-state and r_n is the radius of the ion) of the metallic atom. On the basis of these data of work on the electrodiffusion of hydrogen into hydrides, ionization of the atoms of hydrogen is assumed up to the proton state and transition of its electron to the collective nd-, (n + 1) s-shell. The substitutions of two transition metals with the introduction of the atoms of a third component used the theory of the residual electrical resistance of a binary ordered alloy. The character of the dependence of the residual specific electrical resistance $\Delta_{\rho\,0}$ of the hydride on the concentration of the hydrogen C_H was calculated. It was shown that $\Delta_{\rho\,0}$, being determined by the scattering on the point-defect protons, reaches a maximum value at $C_H = 1$ and is equal to 0 at $C_H = 2$. On the basis of assumptions on the position of hydrogen atoms in the metal, the dependence of the magnetic susceptibility on the hydrogen concentration was considered qualitatively. The comparative growth of the fraction of the Pauli paramagnetism in the hydrides in comparison with the metals was noted. (tr-auth)

24960 THERMAL EVOLUTION SPECTROMETRY OF LOW-ENERGY INERT-GAS IONS INJECTED INTO Cu, UO_2, AND GLASS. Cavaleru, A. O. R.; Morley, C. M.; Armour, D. G.; Carter, G. (Institutul de Fizica Atomica, Bucharest). Radiat. Eff.; 18: No. 1-2, 87-94(Mar 1973).

From international conference on ion-surface interaction, sputtering, and related phenomena; Garching, Germany (Sep 1972).

Low-energy ions were injected into single-crystal Cu, sintered UO_2, and glass and the probabilities of entrapment measured, as a function of ion energy from 50 eV to 3 keV, by heating the targets after irradiation and recording the ratio of quantity of gas released to incident ion fluence. Values of entrapment probability increase from zero at low ion energies to about unity at 1 keV. The rate of thermal gas evolution was also recorded as a function of temperature during the post-bombardment target tempering, enabling deduction of activation energies for evolution. These activation energies are correlated with published data on the annealing of point and extended defects in the solids and with self-diffusion energies. (auth)

24961 SYNTHESIS–FABRICATION OF AN Al_2O_3–TUNGSTEN CARBIDE COMPOSITE. Crayton, P. H.; Greene, E. E. (New York State Coll. of Ceramics, Alfred). J. Amer. Ceram. Soc.; 56: No. 8, 423-426(Aug 1973).

A composite of 70 vol% Al_2O_3 and 30 vol% tungsten carbide was formed by hot-pressing. Simultaneously carbon reacts with an intimate mixture of WO_3 and Al_2O_3 to form a dense body. The composite approached theoretical density; a 1-to-10-μm carbide phase was uniformly dispersed in a 2-μm Al_2O_3 matrix. Maximum density and fine-grained microstructure were obtained when pressure was applied during heating from 1200 to 1600°C and temperature and pressure were then maintained for 20 min. At an initial ratio of 2.8 and 2.9 mol C/mol WO_3, the tungsten appeared as free W, WC, and W_2C. For $C/WO_3 = 3.0$ to 3.6, mixtures of W_2C and WC were present, whereas for $C/WO_3 > 3.6$, free C appeared with WC. The effects of the hot-pressing parameters are discussed. (auth)

24962 NEW DEFECT VANADIUM DIOXIDE PHASES. Chamberland, B. L. (E. I. du Pont de Nemours and Co., Wilmington, DE). J. Solid State Chem.; 7: No. 4, 377-384(Aug 1973).

Two new monoclinic V_2O_4 phases were prepared at high pressure from the regular monoclinic (M_1) form of V_2O_4. The unit cell dimensions for the unmodified monoclinic (M_2) phase are: a = 9.083, b = 5.763, c = 4.532 Å, and $\beta = 91.30°$. The space group C 2/m is consistent with the crystallographic data. The new vanadium dioxide exhibited a structural transition and an abrupt, reversible change in resistivity (about 4 orders of magnitude) at 66°C similar to that observed in M_1-type V_2O_4. This new form of V_2O_4 is believed to be stabilized by chemical and structural defects. Controlled substitution of V^{5+} for V^{4+} in the structure led to yet another monoclinic (M_3) phase. This phase is closely related to the M_2 phase. The M_3 unit cell dimensions are: a = 4.506, b = 2.899, c = 4.617 Å, and $\beta = 91.79°$, having the space group P 2/m. The substitution of V^{3+} yielded only monoclinic (M_1) derivatives. The modified products have varied semiconductor to metal transition temperatures which depend on the type and amount of substitution and defect structure. (auth)

24963 LOW-PRESSURE SINTERING OF BORON NITRIDE USING LOW THERMAL EXPANSION STATIC SINTERING MOLDS. Muta, A.; Hayakawa, Y.; Manaka, M. (to Kabushiki Kaisha Hitachi Seisakusto). U. S. Patent 3,720,740. 13 Mar 1973. Filed date 24 Jun 1970. 6p.

Boron nitride articles are manufactured by first cold-pressure molding boron nitride powder and then sintering the resultant boron nitride article while the article is confined in a sintering mold so that the free expansion of the article during the sintering process is restricted. (Official Gazette)

24964 HOT-PRESSED EUTECTICS OF OXIDES AND METAL FIBERS. Claussen, N. (Max-Planck-Institut fuer Metallforschung, Stuttgart). J. Amer. Ceram. Soc.; 56: No. 8, 442(Aug 1973).

Procedures for preparation of metal–fiber ceramic composites using combined melt and powder metallurgy methods are described. The procedure was applied to preparation of Gd_2O_3 eutectics with Mo fibers and to (Cr, $Al)_2O_3$ eutectics with Cr fibers. It is noted that the hot-pressed fiber eutectics such as those prepared using the described procedure can be expected to exhibit better overall thermal shock resistance than unidirectional metal–fiber–ceramic composites. (JRD)

24965 SINTERED TUNGSTEN–BORON ALLOY. Benesovsky, F. (to Schwarzkopf Development Corp.). U. S. Patent 3,723,076. 27 Mar 1973. Priority date 23 Dec 1968, Austria. 6p.

A sintered tungsten–boron alloy optionally containing small amounts of certain other additives with the boron content of the alloy being less than about 0.05 wt.% and preferably between 0.005 and 0.02 wt.% is described. (Official Gazette)

24966 CERMET POWDERS. Borg, R. J.; Lai, D. Y. F.; Riley, N. R.; Wolfe, J. R. (to California Metallurgical Industries, Inc.). U. S. Patent 3,723,359. 27 Mar 1973. Filed date 8 Jun 1970. 12p.

A metallurgical method is described for making homogeneous powders characterized by ultrafine particle size typically in the range 0.01 to 0.1 microns. First, dry-blend starting materials containing a mixture of carbon and the metal oxides of two or more different metals, one metal having a predetermined carbide forming strength and the other metal having less than the predetermined carbide forming strength. The starting materials are then cold mixed with a liquid prepolymerized furfuryl alcohol resin binder containing a catalyst until a homogeneous mass is obtained. The mass is cold extruded into the shape of an electrode, cured to the desired hardness and then rapidly baked until electrically conductive. The electrode is then connected as the anode in a high intensity electric arc circuit enclosed in a nonoxidizing atmosphere. The arc process consumes the anode and a homogeneous powder is produced out of the characteristic tail flame. The powder comprises a mixture of finely divided particles of metal carbide and metal useful in manufacturing cemented carbide bodies. (Official Gazette)

24967 PREPARATION OF BERYLLIUM HYDRIDE. Wood, J. M. Jr. (to Ethyl Corp.). U. S. Patent 3,743,710. 3 Jul 1973. Filed date 7 Jun 1965. 6p.

A process is described in which a beryllium alkyl is pyrolyzed in the vapor phase to produce beryllium hydride of high purity. (Official Gazette)

24968 PREPARATION OF PURE BERYLLIUM HYDRIDE. Kratzer, R. H.; Paciorek, K. J. L. (to Secretary of the Navy). U. S. Patent 3,729,552. 24 Apr 1973. Filed date 30 Nov 1965. 2p.

A procedure for the preparation of pure beryllium hydride of composition BeH_2 in a quantitative yield is described. This pure beryllium hydride can be utilized as a solid high-energy propellant and in solid-propellant formulations. Pure beryllium hydride, BeH_2, is prepared by the reaction of beryllium borohydride etherate, $Be(BH_4)_2Et_2O$, with triphenylphosphine, $(C_6H_5)_3P$. Beryllium hydride, BeH_2, is freed from the by-product triphenylphosphino-borine, $(C_6H_5)_3PBH_3$ by extraction with benzene. The beryllium hydride prepared by this procedure, according to the hydrogen analysis, is 99 wt % pure. (JRD)

24969 PROCESS FOR PREPARING SPHERES OF URANIUM OXIDE AND URANIUM OXIDE–PLUTONIUM OXIDE, HAVING A CONTROLLED POROSITY. Gerontopoulos, P.; Neri, D.; Renzoni, R. (to Snam Progetti S.p.A.). U. S. Patent 3,728,274. 17 Apr 1973. Priority date 8 Jan 1969, Italy. 6p.

A process is described for the production of a porous refractory material which comprises uranium oxide and an oxide selected from the group consisting of the oxides of thorium, plutonium, beryllium, silicon, aluminum, and magnesium. The process comprises heating the refractory material in an inert or oxidizing atmosphere, replacing the inert or oxidizing atmosphere by a reducing atmosphere, further increasing the temperature of the heated refractory material to produce a material having a porosity of from 2% to 30%. (Official Gazette)

24970 MAGNETIC PROPERTIES OF URANIUM CHALCOGENIDES WITH COMPOSITION CLOSE TO UY_2. Suski, W. (Inst. for Low Temperature and Structure Research, Wroclaw). J. Solid State Chem.; 7: No. 4, 385-399(Aug 1973).

The magnetic and related physical properties of the uranium dichalcogenides are summarized and discussed with regard to their crystal structure. The theoretical magnetic susceptibility calculated on the basis of the usual crystal-field theory is compared with the experimental data. The calculation was carried out under the assumption that the uranium ions have the pure $^3H_4$ term and that there are S^{2-}, Se^{2-} and Te^{2-} ions. Regardless of the crystal environment of the uranium ion in all types of compounds the ground state appears to be a singlet. The results agree with experiment in a considerably broad temperature range. α-Dichalcogenides and U_7Te_{12} exhibit a magnetic transition at low temperatures. Their unusual behavior in this region is discussed in terms of their crystal-field levels, complicated magnetic structure and possible magnetocrystalline anisotropy. (auth)

24971 REFINED CELL PARAMETERS OF THE Ln_2WO_6-TYPE RARE EARTH TUNGSTATES. Brixner, L. H.; Sleight, A. W.; Foris, C. M. (E. I. du Pont de Nemours and Co., Wilmington, DE). J. Solid State Chem.; 7: No. 4, 418-421(Aug 1973).

Rare earth tungstates of the stoichiometry Ln_2WO_6 where Ln =

Ce to Lu have been prepared and their lattice parameters were refined by a least-squares method. They have two structures: the C2/c symmetry for the compositions Ce_2WO_6 through Ho_2WO_6, and a monoclinic group from Er_2WO_6 to Lu_2WO_6 crystallizing most likely in the P2/m or $P2_1/m$ structure. High pressure modifications are described for Dy_2WO_6 and Ho_2WO_6. (auth)

24972 HIGH-TEMPERATURE NEUTRON-DIFFRACTION STUDY OF PURE AND SCANDIA-STABILIZED ZIRCONIA. Barker, W. W.; Bailey, F. P.; Garrett, W. (CSIRO, Wembley, Australia). J. Solid State Chem.; 7: No. 4, 448-453(Aug 1973).

A high-temperature neutron diffraction apparatus has been used to study a section of the zirconia–scandia system; the purpose was to determine whether this technique can be generally applied to phase equilibria studies. The structure of the tetragonal form of zirconia at 1200°C has been confirmed, and the parameters obtained were z(4d) = 0.188 ± 0.002, B_0 = 2.50 Å^2, B_{Zr} = 0.80 Å^2, and R = 0.045. The effect of substituting scandia into the tetragonal zirconia structure was studied and the transformation of the ordered low-temperature β-phase to a grossly nonstoichiometric fluorite phase was also observed. (auth)

24973 PSEUDOPHASE BEHAVIOR IN THE EPSILON AND IOTA REGIONS OF THE PRASEODYMIUM OXIDE–OXYGEN SYSTEM. Turcotte, R. P.; Jenkins, M. S.; Eyring, L. (Battelle Pacific Northwest Labs., Richland, WA). J. Solid State Chem.; 7: No. 4, 454-460(Aug 1973).

Besides line and nonstoichiometric phases, complex oxide systems exhibit reproducible bivariant behavior (termed pseudophases) in the two-phase regions. This occurrence exaggerates chemical hysteresis. Two of these pseudophases in the praseodymium oxide–oxygen system are examined in some detail by tensimetric and high temperature x-ray studies. The tensimetric measurements show marked and progressive shifting of the curves away from stoichiometry with increasing pressure. In addition, unusual reversals are seen to occur both in oxidation and reduction. X-ray-diffraction patterns at temperature are seen to show systematic changes in line positions and line widths. These are analyzed and their implications discussed in terms of suggested structural changes. Similarities and relevance to other systems are suggested. (auth)

24974 INFLUENCE OF CARBON ON THE INTERDIFFUSION OF Mo AND Ni. Heijwegen, C. P.; Rieck, G. D. (Univ. of Tech., Eindhoven, Netherlands). Met. Trans.; 4: No. 9, 2159-2167(Sep 1973).

Experiments are carried out with Ni samples containing different amounts of carbon. The temperature range used is 800 to 1295°C. In the beginning of the diffusion process a layer with a two-phase character is formed, for a high carbon content (i.e., 0.4 wt %) at all temperatures and for a low carbon content (0.06 wt %) below 1200°C. The layer consists of the phases Mo_2C and an η-carbide $Mo_{54}Ni_{30}C_{16}$. Above 1000°C this η-carbide is present also as a single-phase layer adjacent to the two-phase layer. After an incubation time, a layer consisting of another η-carbide Mo_6Ni_6C is formed in the couples; this has a homogeneity range of only 0.5 at.% Ni. There exists an intricate relationship between the two-phase layer and the layers of the pure η-carbides. After a very long annealing time at 1200°C, δ-MoNi appears as a part of the Mo_6Ni_6C layer. (auth)

24975 THERMAL EXPANSION OF MONOCLINIC (ALPHA) Nb_2O_5. Dwivedi, G. L.; Subbarao, E. C. (Indian Inst. of Tech., Kanpur). J. Amer. Ceram. Soc.; 56: No. 8, 443-444(Aug 1973).

Data obtained in measurements of x-ray diffraction reflections of monoclinic Nb_2O_5 at 28°C and thermal expansion coefficients of monoclinic Nb_2O_5 are tabulated and compared with similar data obtained by other workers. (JRD)

24976 METHOD AND APPARATUS FOR MEASUREMENT OF CONCENTRATION OF THERMAL NEUTRON ABSORBER CONTAINED IN NUCLEAR FUEL. Untermyer, S. (to National Nuclear Corp.). U. S. Patent 3,728,544. 17 Apr 1973. Filed date 24 Jul 1970. 6p.

Nuclear fuel samples containing burnable poisons are irradiated with epithermal neutrons and the neutron emission rate is counted to provide a measurement of fissile content through comparisons with the results of like steps performed on reference fuels. Where the fissile content is known, poison content is determined through irradiation of the sample with thermal neutrons. The presence of the poisons depresses the thermal neutron flux within the fuel and reduces the number of fission neutrons emitted. This emission rate is compared with the results of like steps performed on reference rods to indicate poison content. In another embodiment, gamma emission by the fissile species is used in conjunction with thermal-neutron interrogation to measure both fissile and absorber content. (Official Gazette)

24977 SOLID-SOLUTION CARBIDE–GRAPHITE COMPOSITE. Riley, R. E.; Davidson, K. V.; Taub, J. M. (to United States Atomic Energy Commission). Australian Patent 427,498. 25 Aug 1972. Priority date 12 May 1967, United States of America (USA).

In this method of forming solid-solution carbide–graphite composites, powdered graphite is mixed with powdered carbides of tantalum and niobium and the resulting powdered mixture is hot pressed at a temperature of about 3050°C and pressure of about 3200 psi for about 10 minutes. The mixture has a composition of 54 vol % graphite–46 vol % carbides, and the wt % ratio of niobium carbide to tantalum carbide being in the range of 70 to 50%. (Official Gazette)

24978 YTTRIUM SESQUICARBIDE. Krupka, M. C.; Giorgi, A. L.; Krikorian, N. H.; Szkiarz, E. G. (to United States Atomic Energy Commission). Australian Patent 427,066. 4 Aug 1972. Priority date 23 Feb 1968, United States of America (USA).

A method is presented for preparing bcc Y_2C_3 in which a composition $YC_{1.2}$ to $YC_{1.5}$ is arc melted and the melted material is subjected to pressures in the range of 15 to 25 kbar and temperatures of 1250 to 1350°C for a period of 3 to 6 minutes and then quenched at this elevated pressure. (Official Gazette)

24979 RELATIONSHIP BETWEEN V^{4+} AND Mo^{6+} CONTENTS IN V_2O_5 DOPED WITH MoO_3. Pieters, T. W. J.; Kuilenburg, J. M. (Rijksuniversiteit, Utrecht). Z. Anorg. Allg. Chem.; 399: No. 2, 170-174(Jul 1973).

The V^{4+} content in V_2O_5 doped with MoO_3 is measured by a spectroscopic method. The influence of the oxygen pressure is also considered. Up to roughly 3.5 at. % Mo/(Mo + V) the V^{4+} fraction is equal to the Mo^{6+} fraction for samples sintered in air. Increase of pO_2 gives a decrease in the measured values of the V^{4+} fraction for the 5, 10 and 33 at. % Mo-doped samples. (auth)

24980 FABRICATION AND PROPERTIES OF LITHIUM HYDRIDE. Montgomery, C. D. (Oak Ridge Y-12 Plant, TN). Nucl. Eng. Des.; 25: No. 2, 309-314(1973).

Lithium hydride, a crystalline material and relatively stable, can be used for neutron shielding or moderating because of a high hydrogen density and the employment of the ^6Li isotope. Fabrication by powder techniques can supply compacts of near theoretical density. The material is chemically reactive and must be protected from atmospheric moisture. (3 tables, 6 figures, 14 references). (auth)

24981 CERAMIC MATERIALS USED IN THE PRODUCTION OF NUCLEAR ENERGY. de Souza Santos, T. D. (Instituto de Energia Atomics, Sao Paulo, Brazil). Ceramica (Sao Paulo); 17: No. 65, 36-59(1971). (In Portuguese).

This review discusses such topics as: behavior of UO_2 high-density pellets; conditions for obtaining UO_2 powders and their influence on properties; sintering techniques for fuel pellets; electron microscopy of UO_2 powders; fabrication of fuel elements based on U_3O_8–Al cermets; and fuel elements containing thorium oxide. (51 references) (LMT)

24982 PRESENT UNDERSTANDING OF THE THERMAL PROPERTIES OF GRAPHITE. Kelly, B. T. (United Kingdom Atomic Energy Authority, Salwick, Eng.). High Temp.–High Pressures; 5: No. 2, 133-144(1973).

From Carbon 72; Baden/Baden, Ger. (Jun 1972).

A review is given of the present state of agreement between theory and experiment for the lattice dynamic component of the thermal properties of graphite. The relatively simple models of the lattice dynamics which have been applied to the calculation of the specific heat, thermal vibration amplitudes, thermal expansion coefficients, and thermal conductivities are described in detail and the results compared with the experimental data. The consequences of those measurements regarding theories of the interatomic forces in graphite are discussed in detail. (auth)

24983 FUNDAMENTALS OF NEUTRON SCATTERING BY CONDENSED MATTER. Scherm, R. (Institut Max von Laue-Paul Langevin, Grenoble, France). Ann. Phys. (Paris); 7: No. 5, 349-370(Sep 1972).

The basic principles concerning the scattering of neutrons by condensed matter are presented. Most of the formalism, however, can also be easily extended to magnetic scattering. (FR)

24984 CRITICAL PHENOMENA AND NEUTRON SCATTERING. II. Parette, G. (CEN de Saclay, Gif-sur-Yvette, France). Ann. Phys. (Paris); 7: No. 5, 313-328(Sep 1972).

The experimental results (neutron diffraction) verifying the dynamic scaling laws of Halperin and Hohenberg concerning isotropic magnets of the pure Heisenberg type and coupling of spins and exchange interactions in real ferromagnetics in the region of the critical temperature are reviewed. Data for $RbMnF_3$ (an ideal Heisenberg magnetic) are analyzed in the hydrodynamic region

and in the Néel temperature region, variations in the total magnetization, the susceptibility, and the correlation lengths being considered as a function of temperature. Results concerning the ferromagnetic metals Fe and Ni are also given as well as results on the isotropic ferromagnetic insulators EuS and EuO and the anisotropic ferromagnetic MnF_2. (FR)

24985 THERMAL NEUTRON SCATTERING BY MAGNETIC INTERACTION. Will, G. (Univ. Bonn). Ann. Phys. (Paris); 7: No. 5, 371-405(Sep 1972).

The information that can be obtained on the magnetic properties of solids using neutron-diffraction techniques is discussed. Only cases in which interaction occurs between the magnetic moment of the neutron and the magnetic moments in the crystal are considered, these latter moments usually resulting from unpaired electrons. In addition, the discussion is limited to elastic processes, i.e., without energy transfer between the neutron and the diffusing substance. (FR)

24986 DIFFRACTION OF NEUTRONS BY MAGNETIC SPIRAL STRUCTURES. Felcher, G. P. (Argonne National Lab., IL). Solid State Commun.; 12: No. 11, 1167-1171(1 Jun 1973 1973).

A beam of neutrons of wave vector K incident on a magnetic spiral structure with propagation vector q gives rise to two diffracted beams. These are peaked at $K \cdot q/q \simeq \pm q/2$, and their intensity varies with the direction of K with the same functional form as is derived in the dynamical theory of x-ray diffraction. In real cases the two lines are broad enough to overlap significantly, giving rise to intrinsic double diffraction effects in a multi-domain crystal. These have been observed experimentally in holmium. (auth)

24987 INTEGRATED THERMAL CONDUCTIVITY OF CERAMIC URANIUM DIOXIDE. Lages, S. M.; Guedes, P. M. (Instituto de Pesquisas Radioativas, Belo Horizonte, Brazil). Ceramica (Sao Paulo); 17: No. 65, 67-73(1971). (In Portuguese).

This theoretical study is based on evaluation of experimental data from the literature and considers such factors as temperature range, porosity, stoichiometry, and radiation effects. (LMT)

24988 NONSTOICHIOMETRY IN URANIUM SESQUINITRIDE. Fujino, T.; Tagawa, H. (Japan Atomic Energy Research Inst., Tokai). J. Phys. Chem. Solids; 34: No. 10, 1611-1626(Oct 1973).

A statistical model is proposed for analyzing thermodynamic properties of nonstoichiometric uranium sesquinitride. It consists of the combination of the site exclusion mechanism and cluster formation reactions. The model was applied to the three ionic possibilities of $U_{\alpha}^{4+}U_{\beta}^{5+}N_3^{3-}$, $U^{4+}U^{6+}N_3^{3-}$, and $U_2^{5+}N_3^{3-}$. By fitting the theoretical equations to the experimentally observed data, it was found that the set $U_{\alpha}^{4+}U_{\beta}^{5+}U_3^{5+}$, $\beta = 2$, 1:2 cluster gave the most satisfactory results. From $\beta = 2$, the upper limit of nonstoichiometry is expected to be N/U = 1.75. The result that the 1:2 clusters predominantly exist in U_2N_{3+x} suggests the existence of $UN_{1.75}$ phase. The energy required for nitrogen atom for occupying the lattice site of the crystal, E, was calculated to be −120.5 kcal/mole, and the interaction energy to form clusters, E_c, was −11.07 kcal/mole. (auth)

24989 SINTERED CARBIDES BASED ON Ti−Mo_2C−Ni: METALLURGICAL ASPECTS AND USE OF THE MATERIALS AS CUTTING TOOLS. Carboni, E. Atti Notiz.; 28: No. 2, 107-112(Feb 1973). (In Italian).

The chemical−physical characteristics of TiC−Mo_2C−Ni-based carbides are tabulated. The metallurgical aspects described are wettability, the elimination of graphitic carbon, the function of the combined carbon, and fracture. Examples are given of the use of these materials as cutting tools. The superiority of these carbides to the traditional carbides depends on the capacity of withstanding the erosion caused by the gliding of the shavings at the high temperature caused by the high velocity of the cutting. Economic aspects are briefly considered. (JSR)

24990 EMISSIVITY OF SPUTTERED ZrO_2 AND HfO_2. Zhorov, G. A.; Zakharov, B. M.; Kalugina, V. I. Heat Transfer−Sov. Res.; 5: No. 3, 159-163(1973).

Results are presented of studies concerning the emissivity of total radiation coatings consisting of ZrO_2, HfO_2, and CaO-stabilized ZrO_2. The studies were conducted using electrically heated specimens at 1000 to 2600°K. An analysis of the results is included. (JRD)

24991 REACTIONS BETWEEN PURE CaO CERAMICS AND REFRACTORY METALS. Popil'skii, R. Ya.; Baranova, T. F.; Lipochkin, S. V.; Efimovskaya, T. V. (Inst. of Chemical Tech., Moscow). Refractories (USSR) (Engl. Transl.); 13: No. 11-12, 716-720(1972).

Translated from Ogneupory; 13: No. 11, 29-33, Nov 1972.

Experimental data are presented on the reaction of sintered CaO with W, Mo, Nb, and Ta at a residual pressure of 1×10^{-4} mm Hg in argon. The reaction was assessed visually, by x ray, and by microscopy. Tests were made in a high-temperature vacuum furnace using specially prepared devices for installing the specimens and ensuring complete contact between them at a force of approximately 0.1 kg/cm². Noticeable reactions were observed to be initiated at 1700 to 2000°C. (JRD)

24992 THERMOELECTRIC PROPERTIES OF SEMICONDUCTING MATERIALS WITH A NONSTANDARD CONDUCTION MECHANISM. Golikova, O. A.; Zaitsev, V. K.; Petrov, A. V.; Stil'bans, L. S.; Tkalenko, E. N. Institute of Semiconductors, Academy of Sciences of the USSR, Leningrad). Sov. Phys.-Semicond. 6: No. 9, 1488-1491 (Mar 1973).

The temperature dependences of the electrical conductivity (σ) and the thermoelectric power (α) were determined for boron, boron carbide, and α-AlB_{12} in the 300–1800°K range. The temperature dependences of the thermal conductivity (α) were obtained for boron in the 200–1600°K range, and for boron carbide and AlB_{12} in the 200–1100°K range. The temperature dependences of α and σ indicated that impurity conduction in boron carbide and AlB_{12} was of the hopping nature. The thermal conductivity α was constant at high temperatures because of the complex crystal structure of the investigated materials. The results indicated that the materials with hopping conduction could be used in high-temperature thermoelectric applications. (auth)

24993 STACKING-FAULT ENERGY IN MOLYBDENUM DITELLURIDE. Agarwal, M. K. (Sardar Patel Univ., Gujarat, India). Indian J. Pure Appl. Phys.; 11: No. 3, 219-220(Mar 1973).

Data on the stacking fault energy of $MoTe_2$ crystals calculated from the geometry of the twofold ribbons and extended nodes are presented. Depending upon the value of the stacking fault energy, the dislocations in $MoTe_2$ are divided into three groups and attributed to the presence of different polytypes of $MoTe_2$. (auth)

24994 THERMAL EXPANSION OF SCANDIUM BORATE. Rao, K. V. K.; Murthy, K. S. (Osmania Univ., Hyderabad, India). Indian J. Pure Appl. Phys.; 11: No. 3, 230-231(Mar 1973).

Precision lattice parameters of scandium borate have been determined at different temperatures by the x-ray method in the temperature range 30 to 702°C, using a Unicam 19-cm high-temperature powder camera. The data have been used to evaluate the coefficients of thermal expansion, $\alpha_{||}$ along the c-axis and $\alpha_{\perp}$ at right angles to the c-axis. The temperature (T) dependence of the coefficients is represented by the following equations: $\alpha_{||} = 9.499 \times 10^{-6} + 8.945 \times 10^{-8}T - 1.418 \times 10^{-12}T^2$ and $\alpha_{\perp} = 1.143 \times 10^{-6} + 3.580 \times 10^{-8}T + 2.581 \times 10^{-12}T^2$ where T is in °C. (auth)

24995 SYSTEMATICS IN THE FISSION TRACK ANNEALING OF MINERALS. Haak, U. (Univ., Goettingen, Ger.). Contrib. Miner. Petrol.; 35: 303-312(1973).

A linear relationship exists between annealing temperatures and activation energies of fission tracks for different minerals. The temperature and activation energy needed to erase 50% of the tracks in minerals depend on the lattice energy per mole. These relationships make possible predictions about the stability of tracks in silicates, provided their chemical composition is known or a few isochronal annealing data are available. (GE)

24996 PREPARATION BY VAPOR-PHASE TRANSPORT AND CHARACTERIZATION OF SINGLE CRYSTALS OF THE TERNARY OXIDE $V_{1-x}Nb_xO_2 (0 \leq X \leq 0.33)$. Launay, J. C.; Villeneuve, G.; Pouchard, M. (Univ., Bordeaux). Mater. Res. Bull.; 8: No. 8, 997-1005(Aug 1973). (In French).

Single crystals of $V_{1-x}Nb_xO_2$ ternary oxide ($0 \leq x \leq 0.33$) are prepared by chemical transport using $TeCl_4$. The compositions are determined by thermogravimétric analysis under oxygen, x-ray diffraction measurements and evaluation of the insulator−metal transition temperature. (auth)

24997 PREPARATION OF V_2O_3 SINGLE CRYSTALS BY A CHEMICAL-TRANSPORT REACTION. Peshev, P.; Bliznakov, G.; Gyurov, G.; Ivanova, M. (Inst. of General and Inorganic Chemistry, Sofia). Mater. Res. Bull.; 8: No. 8, 915-924(Aug 1973).

The preparation of vanadium sesquioxide single crystals by chemical transport was studied. On the basis of thermodynamic analysis it was shown that chlorine is one of the most suitable carriers of V_2O_3. The dependence of the rate of transport on the temperature gradient, as well as on the carrier concentration and the temperature of the crystallization zone, was studied experimentally. The effect of the conditions under which the transport process takes place on the form and dimensions of the crystals has been investigated. (auth)

24998 TOUGHNESS OF WC−15% Co. Chermant, J. L. (Univ. of Caen, France); Deschanvres, A.; Iost, A.; Meyer, R. Mater. Res. Bull.; 8: 925-934(Aug 1973). (In French)

Fracture mechanics were applied to the brittle material WC–15 wt % Co by a bend test of notched specimens in order to determine, by several methods, the fracture energy γ and the fracture toughness. The experimental results indicate that the K_{IC} value so determined represents a lower limiting value of fracture toughness, which is 19 ± 2 MP$\sqrt{m}$. The critical notch radius is about 70 μm. (auth)

24999 ORDER STATES OF A FLUORITE-TYPE SOLID SOLUTION OF THE ZIRCONIA–LIME SYSTEM FOR THE COMPOSITION 4 ZrO_2–CaO. Michel, D. (CNRS, Vitry-sur-Seine, France). Mater. Res. Bull.; 8: No. 8, 943-949(Aug 1973). (In French).

Ordering occurs in calcia-stabilized zirconia at the composition 4 ZrO_2–CaO. Depending on the temperature, two phases are obtained. Their structures were studied by x-ray diffraction; their relation to the fluorite structure is discussed. (auth)

25000 ELECTRICAL CONDUCTIVITY OF PURE AND CaO-DOPED ThO_2 CERAMICS. Mehrotra, A. K.; Maiti, H. S.; Subbarao, E. C. (Indian Inst. of Tech., Kanpur). Mater. Res. Bull.; 8: No. 8, 899-907(Aug 1973).

The ac total conductivity (σ) of pure and CaO-doped thoria samples was measured in air in the temperature range of 600 to 1400°C. For each sample, the activation energy for conduction was calculated from a plot of σT vs. $1/T$, where T is absolute temperature. The results have been compared with those existing on both ThO_2–CaO and ThO_2–$YO_{1.5}$ ceramics. (auth)

25001 ION IMPLANTATION OF ZnS. Georgobiani, A. N.; Kotlyarevskii, M. B.; Zlobin, V. N.; Todual, P. A.; Generalov, Yu. P.; Dement'ev, B. P. (Lebedev Inst. of Physics, Moscow). Mater. Res. Bull.; 8: No. 8, 893-897(Aug 1973).

The properties of ZnS single crystals doped by Ag ion implantation (an acceptor) and zinc (a donor) were investigated. The annealing of the Ag-doped samples in H_2 resulted in an occurrence of the "silver" luminescence centers with the photoluminescence maximum at 454 nm. The doped layer depth is ~500Å at an ion energy of 45 keV. On annealing of the samples in the S and ZnS vapors, the doped layer acquires the p-type conductivity. The doping of n-type ZnS crystals by Zn ions increases their conductivity. At the smooth decrease in the ion beam energy the "ohmic" contact is obtained on the samples. (auth)

25002 HEAT CAPACITY OF METALLIC V_2O_3 AT HIGH PRESSURE. McWhan, D. B.; Remeika, J. P. (Bell Laboratories, Murray Hill, New Jersey 07974); Bader, S. D.; Triplett, B. B.; Phillips, N. E. Phys. Rev. B 7: No. 7, 3079-3083 (1 Apr 1973).

The heat capacity of V_2O_3 has been measured between 0.3 and 10 K at pressures of 1 and 25 kbar. The results confirm that the very high electronic heat capacities measured for doped samples are characteristic of pure V_2O_3 in the metallic phase. (auth)

25003 THERMAL EFFECTS DURING THE FORMATION AND DISSOLUTION OF ANODIC TANTALUM OXIDE. Pringle, J. P. S. (Chalk River Nuclear Labs., Ont.). J. Electrochem. Soc.; 120: No. 9, 1184-1187(Sep 1973).

Anodic films formed on tantalum at 10 mA/cm^2 were found to be thicker at the top of the specimen than at the bottom. The effect has been traced to a temperature difference resulting from the presence of convection currents in the electrolyte; these currents are powered by the heat released during anodization. The oxide thickness is thus very sensitive to changes in the anodizing temperature, and this sensitivity has been used to determine the temperature rise within the film itself. Convection currents during the dissolution of the oxide in buffered HF give rise to similar thickness variations, from which it has been concluded that the oxide dissolves exothermically. (auth)

25004 GROWTH OF HIGH-PURITY CdTe SINGLE CRYSTALS BY VERTICAL ZONE MELTING. Triboulet, R.; Marfaing, Y. (CNRS, Meudon-Bellevue, France). J. Electrochem. Soc.; 120: No. 9, 1260-1265(Sep 1973).

The synthesis of CdTe in a Bridgman furnace, under determined vapor pressure of cadmium, and its purification by the vertical zone-melting technique, is described. The influence of the thermodynamic state of the crystals after synthesis on the conductivity type of the zone-melted purified material is shown. Purity, homogeneity, and compensation of the material, as determined by electrical measurements, photoluminescence, and spectrographic trace analysis, are presented and discussed. (auth)

25005 INVESTIGATION OF THE ELECTRICAL RESISTIVITY OF ZIRCONIUM AND HAFNIUM NITRIDES. Petrova, I. I.; Petrov, V. A.; Ermakov, B. G.; Sokolov, V. V. (Institute of High Temperatures, Academy of Sciences of the USSR). High Temp. 10: No. 5, 905-909 (May 1973).

The results are given of measurements of the electrical resistivity of stoichiometric zirconium and hafnium nitrides, prepared by precipitation from the vapor phase. The measurements were carried out in the temperature range 1200–2500°K. It was found that the electrical resistivity of these materials was much less than that of the materials of the same composition prepared by the powder metallurgy methods. (auth)

25006 THEORY OF MAGNETIC PHASE TRANSITIONS IN METALLIC ACTINIDE COMPOUNDS. Erdoes, P.; Robinson, J. M. (Florida State Univ., Tallahassee). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 10, 1070-1074(1973).

From 18th annual conference on magnetism and magnetic materials; Denver, Colorado, USA (28 Nov 1972). See CONF-721114-P2.

The intriguing sharp multiple magnetic phase transitions in UP and NpC are explained on the basis of a model which involves an exchange-aided electron delocalization transition. Quantitative agreement with sublattice magnetization, magnetic susceptibility, electron effective mass, and latent heat data is obtained. (17 references) (auth)

25007 POLARIZED PHOTOELECTRONS FROM PURE AND DOPED EuO SINGLE CRYSTALS. Sattler, K.; Siegmann, H. C. (Swiss Federal Inst. of Tech., Zurich). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 10, 1274-1278(1973).

From 18th annual conference on magnetism and magnetic materials; Denver, Colorado, USA (28 Nov 1972). See CONF-721114-P2.

Measurements of photoelectron spin polarization on single crystal surfaces give evidence of a paramagnetic sheet at the surface of Heisenberg ferromagnets. Doping enhances the molecular field in the surface. It is suggested that the electron escape depth is a function of surface magnetization. For $Eu_{1-x}La_xO$ ($x \sim 1\%$), $P \cong 80\%$, which is the highest electron polarization observed in a photoemission experiment so far. (auth)

25008 BOUND MAGNETIC POLARONS AND THE SUSCEPTIBILITY OF EuO. McGuire, T. R.; Torrance, J. B.; Shafer, M. W. (IBM Research Center, Yorktown Heights, NY). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 10, 1289-1293(1973).

From 18th annual conference on magnetism and magnetic materials; Denver, Colorado, USA (28 Nov 1972). See CONF-721114-P2.

Magnetic susceptibility (χ) measurements at temperatures up to 700°K were made on samples of Eu-rich EuO which show insulating, metal–insulator, and metallic conductivity. Above 200°K, χ obeys a Curie–Weiss law with a molar Curie constant of $C_M = 7.7$ for all samples. The value of θ, however, increases from 76 to 84°K with increasing Eu concentration. This increase is interpreted as evidence that the electrons associated with excess Eu are contributing to the exchange interaction. The increase in θ is inconsistent with the He-like model for the metal–insulator transition but is consistent with a model of bound magnetic polarons. The constant value of C_M at high temperatures indicates that the ordering within the polarons is relatively weak. Results are also compared to the susceptibility measurements of Menyuk, Dwight and Reed, on EuO. (auth)

25009 DISORDERED BOND MODEL FOR $V_{1-x}Cr_xO_2$. Rice, T. M. (Bell Telephone Labs., Murray Hill, NY). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 10, 1406-1410(1973).

From 18th annual conference on magnetism and magnetic materials; Denver, Colorado, USA (28 Nov 1972). See CONF-721114-P2.

A model is proposed for the M_3 phase of $V_{1-x}Cr_xO_2$, in which all V atoms are locally bonded, but the arrangement of the bonds on half the V sites is disordered. In the average structure, seen by classical x-ray methods, these V atoms appear to be unbonded. It is further proposed that at M_3–M_2 these V sites become localized V^{4+} atoms. Brief comments are made on other VO_2 alloy systems. (17 references) (auth)

25010 NMR STUDIES ON ANTIFERROMAGNETIC STATE OF V_2O_3–Cr_2O_3. Yasuoka, H. (Kyoto Univ.); Motoya, K.; Nakamura, Y.; Remeika, J. P. AIP (Amer. Inst. Phys.) Conf. Proc.; No. 10, 1411-1415(1973).

From 18th annual conference on magnetism and magnetic materials; Denver, Colorado, USA (28 Nov 1972). See CONF-721114-P2.

Magnetic properties of the antiferromagnetic state of the V_2O_3–Cr_2O_3 mixed system were investigated with a pulsed NMR technique. For pure V_2O_3, the hyperfine field studies lead to the conclusion that the magnetic moment of 1.2 μ_B/V-atom is mainly due to the spin moment which lies at 71° to the hexagonal c-axis. There was no evidence of spin-flop in field less than 60 kOe. In the mixed system, $(V_{1-x}Cr_x)_2O_3$, the ^{51}V NMR frequency was not changed, while the intensity fell off more rapidly with increasing x than expected from a simple dilution. (auth)

25011 SYSTEMATICS OF THE MAGNETIC PROPERTIES OF NEPTUNIUM MONOPNICTIDES. Lam, D. J.; Dunlap, B. D.; Aldred, A. T.; Nowik, I. (Argonne National Lab., IL). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 10, 83-87(1973).

From 18th annual conference on magnetism and magnetic materials; Denver, Colorado, USA (28 Nov 1972). See CONF-721114-P1.

The magnetic properties of the neptunium monopnictides NpN, NpP, NpAs, and NpSb, determined by magnetization and Moessbauer effect measurements, are summarized. The magnetic structures change from ferromagnetic in NpN to longitudinal wave (LW) in NpP and probably in NpAs to simple antiferromagnetic in NpSb. The systematic variation of the magnetic structure and the existence of LW order indicates that the exchange interaction between the magnetic ions must be long-range and oscillatory in real space. (auth)

25012 MAGNETIC AND METAL-INSULATOR TRANSITION IN THE MAGNELI PHASE V_nO_{2n-1}. Kachi, S. (Kyoto Univ.). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 10, 714-722(1973).

From 18th annual conference on magnetism and magnetic materials; Denver, Colorado, USA (28 Nov 1972). See CONF-721114-P1.

Metal–insulator phase transitions were found in all the Magneli phases V_nO_{2n-1} (n = 3 to 9) except V_3O_5 and V_7O_{13}. The V_7O_{13} phase remains metallic down to 4.2°K. In addition, phases with n = 3, 4, 5, 6, 7, 8 order magnetically at a lower temperature. These electrical and magnetic properties are collated and reviewed in summarized form. (7 figures, 31 references) (auth)

25013 DISTRIBUTION OF SODIUM IN SPUTTERED SiO_2 AS DETERMINED BY NEUTRON ACTIVATION AND UV SPECTROGRAPHIC ANALYSES. Kumar, S.; Gregor, L. V. (International Business Machines Corp., Hopewell Junction, NY). J. Electrochem. Soc.; 120: No. 9, 1285-1287(Sep 1973).

The presence and distribution of Na in sputtered SiO_2 was investigated. Results show that most of the sodium appears concentrated on the top surface of the sputtered SiO_2, because the amount of sodium decreases to a relatively small level upon etching. This finding was checked by neutron activation analysis. The materials that commonly come in contact with sputtered SiO_2 were analyzed by uv spectrographic, flame photometry, and neutron activation techniques. The stainless steel shield contained the largest amount of sodium (8 ppM) of all the materials examined. This sodium could be incorporated into films as a result of resputtering. (JRD)

25014 INFLUENCE OF VACANCY ORDERING ON THERMOPHYSICAL PROPERTIES OF VANADIUM CARBIDE. Williams, W. S. (Univ. of Illinois, Urbana). High Temp. - High Pressures; 4: No. 6, 627-638(1972).

From 3rd European conference of thermophysical properties; Turin, Italy (20 Jan 1972).

The cubic carbides of the transition metals contain many vacancies on the fcc carbon sublattice. These vacancies do not in general exhibit long-range order. However, in vanadium carbide at least two ordered phases are known, V_6C_5 and V_8C_7. Transitions between these phases and their corresponding disordered phases, $VC_{0.833}$ and $VC_{0.875}$, occur between 1100 and 1300°C. Electrical resistivity and enthalpy changes associated with these order–disorder transitions were studied. The resistivity changes discontinuously at the transition temperatures indicating that the transitions are first order. The amount of the drop for the ordered phases is ~10% at the transitions, but the residual resistivities at liquid helium temperature are reduced to small fractions of the values typical of disordered carbides. A value of 3.3 ± 1.0 cal g^{-1} was obtained for the latent heat for $V_6C_5 = VC_{0.833}$. The total enthalpy changes for the two transitions were found to be approximately equal, 6.6 ± 2.9 and 7.0 ± 3.1 cal g^{-1}. These values include those predicted from the measured transition temperatures and an extension of the Bragg–Williams theoretical model for order–disorder transitions. The measured isobaric specific heat below the critical temperature has the form A ln $|\epsilon|$ + B. (auth)

25015 ELECTRIC CONDUCTIVITY AND THERMOELECTRIC FORCE OF PURE AND CALCIUM OXIDE-STABILIZED ZIRCONIUM OXIDE AT TEMPERATURES BETWEEN 1,000 AND 1,700°C AND OXYGEN PARTIAL PRESSURES BETWEEN 1 AND 10^{-16} ATM. Fisher, W. A.; Pieper, C. (Max-Planck-Institut fuer Eisenforschung, Duesseldorf, Ger.). Arch. Eisenhuettenw.; 44: No. 4, 251-259(1973). (In German).

Review is made of literature with respect to electrical conductivity and thermoelectric power of pure and doped zirconia. A description is given of devices for the measurement of electrical conductivity and thermoelectric power of zirconia. The dc and ac conductivity of pure zirconia and zirconia doped with 13 mole % CaO at temperatures between 1,000 and 1,650°C and oxygen partial pressures between 10^{-16} and 1 atm is discussed. Critical comments are offered on thermoelectric power of zirconia and zirconia doped with 13 mole % CaO as a function of temperature and oxygen partial pressure of the atmosphere. Supplementary to this report, E. Foerster and H. Richter, Oberhausen, discuss the problem of the limits of application of stabilized zirconium dioxide as solid electrolytes for electrochemical determination of oxygen in molten steel. (GE)

25016 REACTIONS OF SODIUM OXIDE WITH THE OXIDES VO_2, V_2O_3, VO, AND VANADIUM METAL. Barker, M. G.; Hooper, A. J. (Univ. of Nottingham, Eng.). J. Chem. Soc., Dalton Trans.; No. 15, 1517-1519(1973).

The reactions of sodium oxide with vanadium metal and its lower oxides are described for different molar ratios of reactants. All reaction products are identified by powder x-ray crystallography and the reaction temperature determined by differential thermal analysis. No ternary oxides containing vanadium in the 4+ state were formed in the reactions of sodium oxide with vanadium dioxide; an equimolar mixture gave $NaVO_2$ and Na_3VO_4. The ternary oxide $NaVO_2$ was prepared by the reaction of vanadium (III) oxide with sodium oxide in equimolar proportions, but sodium orthovanadate Na_3VO_4 was formed at higher sodium oxide concentrations. This product was also formed from reactions of the monoxide and vanadium metal with sodium oxide. (auth)

25017 IMPROVEMENTS IN ATMOSPHERE SINTERING OF TRANSPARENT PLZT CERAMICS. Snow, G. S. (Sandia Labs., Albuquerque, NM). J. Amer. Ceram. Soc.; 56: No. 9 479-480 (Sep 1973).

An improved atmosphere sintering process was developed for fabricating large transparent PLZT plates for electro-optic applications. Cold-pressed 9/65/35 PLZT slugs were sintered in O_2 in Pt crucibles for ≈45 min at 1180°C and were then heat-treated in air for 60 h at 1200°C in Al_2O_3 crucibles containing $PbZrO_3$ atmosphere powder. Transparent plates as large as 8.4 cm in diameter and 1 cm thick were thus fabricated. A mechanism is proposed which qualitatively accounts for the success of this process. (auth)

25018 ISOTHERMAL GRAIN GROWTH OF PRESSURE-SINTERED PLZT CERAMICS. Langman, R. A. (Western Electric Co., Inc., Princeton, NJ); Runk, R. B.; Butler, S. R. J. Amer. Ceram. Soc.; 56: No. 9, 486-488(Sep 1973).

PLZT specimens 99.99% of theoretical density containing 7 at. % La with a 65/35 Zr/Ti atom ratio were fabricated with average grain diameters of ≈1 μm by pressure sintering. The dense, single-phase specimens were isothermally heat-treated in a low PbO activity atmosphere. For grain diameters from 1 to 5 μm, grain growth obeyed the $D^3 - D_0^3 = k't$ relation, with an apparent activation energy of 86 kcal/mol. The mechanism controlling the grain-growth rate is consistent with a solid-solution impurity drag caused by an La ion concentration gradient near the grain boundaries. (auth)

25019 FERMI SURFACE OF CADMIUM UNDER PRESSURE. Bryant, H. J. Tucson, AZ; Univ. of Arizona (1973). 65p. University Microfilms Order No. 73-20,672.

Thesis (Ph. D.).

Six extremal cross sectional areas S of the Fermi surface of cadmium were measured at pressures up to 25 bars. The de Haas-van Alphen effect was used at temperatures from 0.4 to 1°K with magnetic fields from 7 to 26 kG to measure d(lnS)/dP for both the electron and hole sheets of the Fermi surface. The logarithmic pressure derivatives of the third band electron sheet are d(lnS)/dP = (1.6 ± 0.4) × 10^{-3} $(kbar)^{-1}$ and (–2.3 ± 0.2) × 10^{-3} $(kbar)^{-1}$ with the field H along [0001] and [11$\bar{2}$0], respectively. This high anisotropy demonstrates that pressure-induced changes in the pseudopotential play an important role in the effects of pressure on the Fermi surface in this metal. Logarithmic pressure derivatives for the first band cap and second band monster hole sheets were measured under similar conditions. The derivative d(lnS)/dP for the cap is (–13.2 ± 0.1) × 10^{-3} $(kbar)^{-1}$ with the field along [11$\bar{2}$0]. With the field along [0001], the monster and cap pressure derivatives are in agreement with previous measurements. Some of the data however, are sufficiently accurate to deduce the relative logarithmic derivative of the cap-monster interaction with the AHL Brillouin zone plane, $d(\ln S_c)/dP - d(\ln S_m)/dP$. This yields (–7 ± 5) × 10^{-3} $(kbar)^{-1}$ for the derivative $d(\ln S_A)/dP$ of the annular area S_A enclosed between the cap and monster. This pressure derivative is used to discuss the pressure variation in the spin–orbit coupling that removes the degeneracy between the cap and monster surfaces on this zone plane. The observed pressure derivatives are compared with models. The electron model fails to predict all the correct signs. The 2-OPW model for the lens is fit to the experimental deriva-

tives by arbitrary variations of the Fermi energy and potential, which are roughly the same as those predicted theoretically. Semiquantitative agreement with all of the experimental derivatives is achieved with the nine-parameter band structure model of R. W. Stark when the pseudopotential parameters are considered to be a smooth function of the magnitude of the reciprocal lattice vectors and the Fermi level is fixed by compensation of the number of electron states (n_e) and the number of hole states (n_h), i.e., $n_e = n_h$. (Diss. Abstr. Int., B)

25020 COMPARISON OF THERMAL-STRESS RESISTANCE OF POLYCRYSTALLINE Al_2O_3 AND BeO. Krohn, D. A.; Larson, D. R.; Hasselman, D. P. H. J. Amer. Ceram. Soc.; 56: No. 9, 490-491(Sep 1973).

The thermal shock resistance of Al_2O_3 and BeO is compared using the two criteria based on the thermal shock required to cause fracture and on the degree of damage (strength loss) incurred under inevitable fracture conditions. On the basis of the first criterion, BeO is superior to Al_2O_3, while for $\Delta T > 300°C$, Al_2O_3 is superior according to the second criterion. These differences are analyzed semiquantitatively. (DLC)

25021 PHASE TRANSFORMATION OF MONOCLINIC ZrO_2 SINGLE CRYSTALS. Mitsuhashi, T.; Fujiki, Y. J. Amer. Ceram. Soc.; 56: No. 9, 493(Sep 1973).

The phase transformation was studied using DTA. For heating rates of 0.625 to 20°/min, the transformation temperatures (tt) for 60 crystals were in the range 1160 ± 3° to 1190 ± 3°C; on cooling, the tt ranged from 1070 ± 3 to 1100 ± 3°C. The tt and velocity are independent of heating rate and impurities; differing tt for individual single crystals may be related to differences in nucleation sites. (DLC)

25022 APPLICATION OF DEFORMATION MAPS TO THE STUDY OF IN REACTOR BEHAVIOR OF OXIDE FUELS. Roberts, J. T. A.; Voglewede, J. C. (Argonne National Lab., IL). J. Amer. Ceram. Soc.; 56: No. 9, 472-475(Sep 1973).

Deformation maps that describe the mechanical behavior of oxide nuclear fuels in and out of reactor were constructed from experimental data using the approach of Ashby. By incorporating the effects of changes in composition and microstructure into the rate equations, a map was constructed to describe the in-reactor mechanical behavior of a fully restructured mixed (U, Pu) oxide fuel. The implications of this map are discussed in relation to the modeling of fuel behavior. (3 figures, 18 references) (auth)

25023 TEMPERATURE DEPENDENCE OF THE HYPERFINE INTERACTION OF TRIVALENT GADOLINIUM IN SINGLE-CRYSTAL THORIUM OXIDE. Marshall, S. A. (Argonne National Lab., IL); Nistor, S. V.; Huang, C. Y.; Marshall, T. Phys. Status Solidi (b); 59: No. 1, 55-61(1 Sep 1973).

Hyperfine structure splittings for the $M = -1/2 \rightarrow 1/2$ transition of trivalent gadolinium in single-crystal thorium oxide were measured from 1.25 to 350°K. The temperature dependence of these splittings is interpreted in terms of a modified Šimánek-Orbach theory. (20 references) (auth)

25024 X-RAY DIFFRACTION AT HIGH TEMPERATURES (ABOVE 2000 K). Traverse, J. P. (CNRS, Montlouis, France). Rev. Int. Hautes Temp. Refract.; 10: No. 2, 125-129(Apr 1973). (In French).

In the last ten years (1962-1972), important developments have taken place in the field of x-ray-diffraction studies at high temperatures (above 2000°K). A bibliography is presented of the various work effected in this field. The first part of the bibliographic review concerns the different techniques used. The second part of the review concerns the various results obtained. A distinction is drawn between the different results obtained for carbides and carbon and nitrides and oxides. (auth)

25025 NONSTOICHIOMETRY IN THE SYSTEM FeF_3-WO_3. Tressaud, A.; Dance, J. M.; Menil, F.; Portier, J.; Hagenmuller, P. (Univ., Bordeaux). Z. Anorg. Allg. Chem.; 399: No. 2, 231-238(Jul 1973). (In French).

The FeF_3-WO_3 system was investigated by radiocrystallographic, magnetic, and Moessbauer spectroscopy measurements. At 600°C a solid solution appears up to 74% WO_3. Microdomains of FeF_3, spread out in a matrix of a disordered $Fe_{1-x}W_xO_{3x}F_{3-x}$ solid solution, are detected; they disappear by appropriate annealing. (auth)

25026 PREPARATION OF UC-RICH SOLID SOLUTIONS IN THE UC-US SYSTEM. Lovell, G. H. B.; Van Tets, A.; Britz, E. J. (Atomic Energy Board, Pretoria). J. Nucl. Mater.; 48: No. 1, 74-78(Aug 1973).

A two-stage procedure for the preparation of UC-US solid solutions rich in UC is described. In the first stage, UC is reacted with insufficient carbon to obtain complete conversion of the UO_2 to UC, thus yielding a UC-U cermet. In the second stage, the finally ground cermet is reacted with the stoichiometric amount of zinc sulphide, ZnS, to convert the uranium metal present to US. By this means, UC-US solid solutions have been prepared containing between 3 and 20 mol % US. By the use of uranium disulphide, US_2, in place of ZnS, this maximum figure can be increased to about 33 mol %. Results of chemical analysis and examinations by x-ray diffraction and metallurgical techniques are reported. The method is also applicable to the synthesis of other UC-UX materials where X may be phosphorus or chalcogens other than sulfur. (auth)

25027 REACTIONS OF LIQUID SODIUM WITH TRANSITION-METAL OXIDES. Pt. 6. Oxides of Vanadium. Barker, M. G.; Hooper, A. J. (Univ. of Nottingham, Eng.). J. Chem. Soc., Dalton Trans.; No. 15, 1520-1522(1973).

Vanadium pentoxide is reduced by liquid sodium to the oxide V_2O_3 and sodium oxide at low temperatures (150°C). On increasing the temperature (up to 600°C) the ternary oxides Na_4VO_4 and $NaVO_2$ are produced. Vanadium dioxide reacts at 150°C to form the oxide $NaVO_2$ which is stable to liquid sodium up to 600°C. Vanadium(III) oxide, V_2O_3, reacts with liquid sodium to give a mixture of the ternary oxide, $NaVO_2$, and the monoxide, VO; the latter oxide is stable to pure liquid sodium up to 600°C but may be oxidized by solutions of oxygen in liquid sodium to $NaVO_2$ which may be further oxidized by oxygen in sodium to Na_4VO_4. (auth)

25028 ELECTRICAL CONDUCTIVITY AND X-RAY STUDY OF A HIGH-TEMPERATURE TRANSITION IN U_4O_9. Naito, K.; Tsuji, T.; Matsui, T. (Nagoya Univ., Japan). J. Nucl. Mater.; 48: No. 1, 58-66(Aug 1973).

The high-temperature transition in U_4O_9 was studied by electrical conductivity measurements and x-ray diffraction. From the electrical conductivity measurements, a similar variation of log σT with reciprocal temperature to that in the transition range near room temperature is observed in the temperature range from about 300 to 800°C. Like the low-temperature transition, a small lattice contraction is also observed in that temperature range by means of x-ray diffractometry, and the transition temperature increases from 530 to 620°C with increasing O/U ratio. After the transition, the intensity of 4 a_0 superlattice reflections increases, but that of 8 a_0 superlattice reflections disappears. The mechanism of this high-temperature transition is considered to be a second-order transition of the order-disorder type based on the configurational change of U^{4+} and U^{5+} with the shift of some portions of the lattice oxygen atoms from the lattice sites to the interstitial positions. The phase diagram of U_4O_9 is presented on the basis of the electrical conductivity and x-ray data. (4 tables, 10 figures, 25 references) (auth)

25029 PHASE STRUCTURE OF THE SYSTEM NiO-MoO_3. Pilipenko, F. S.; Tsailingol'd, A. L.; Levin, V. A.; Tuktarova, L. S.; Stepanov, G. A.; Boreskov, G. K.; Buyanov, R. A.; Andrushkevich, M. M. (Inst. of Catalysis, Novosibirsk, USSR). Kinet. Katal.; 14: No. 3, 752-755(1973). (In Russian).

The phase structure of oxides of the Ni-Mo system was studied by the DTA method and radiography in a wide interval of Ni and Mo ratios. Four phases were detected and identified: nickelous oxide, molybdenum trioxide, and normal and non-stoichiometric nickel molybdate. (tr-auth)

25030 ELECTRICAL CONDUCTIVITY OF CERMETS OF THE SYSTEMS ZrO_2-Mo AND Al_2O_3-Fe BETWEEN 20 AND 1,700°C. Fischer, W. A.; Pieper, C. (Max-Planck-Institut fuer Eisenforschung, Dusseldorf). Arch. Eisenhuettenw.; 44: No. 6, 483-488 (1973). (In German).

The electric conductivity was examined in atmospheres of pure hydrogen and argon for its dependence upon the chemical composition. The measured conductivity could be satisfactorily described with the aid of a polyhedron model and a series or parallel connection of resistances. At a metallic volume fraction of only 0.2, the cermets already reveal the negative temperature coefficient of the metallic conductivity. The slopes of the temperature dependences of the conductivity of the cermets were similar to those of the starting material. Whereas the conductivity of the electron-conductive ZrO_2 increased by addition of molybdenum, the conductivity of the stabilized ion-conductive ZrO_2 decreased with a volume fraction of molybdenum up to 0.1, whereby polarization phenomena occurred between the oxygen ions and the metallic grains. The dependence of the conductivity of cermets on the grain size of the mixture fractions could not be ascertained on Al_2O_3-Fe specimens in the examined range from 0.03 to 0.25 mm. (GE)

25031 PREPARATION METHOD OF CUBIC BORON NITRIDE. Wentorf, R. H. Jr.; Rocco, W. A. (to General Electric Co.). German Patent 2,232,225. 18 Jan 1973. 29p. (In German).

A process is given for the transformation of hexagonal boron nitride into cubic boron nitride. The hexagonal form, in the presence of a catalyst, is exposed to a pressure of 50 kilobars and a temperature of at least 1,400°C simultaneously, thus entering the region in the state diagram where the cubic form of boron nitride is the stable phase. An alloy of aluminum and at least one of the metals cobalt, nickel, and manganese or a carbide sinter material can be used as catalyst. (GE)

25032 OXYGEN POTENTIAL OF IRRADIATED URANIA–PLUTONIA FUEL PINS. Johnson, I.; Johnson, C. E.; Crouthamel, C. E.; Seils, C. A. (Argonne National Lab., IL). J. Nucl. Mater.; 48: No. 1, 21-34(Aug 1973).

The oxygen-potential gradient in irradiated urania–plutonia fuel pins was estimated from the distribution of molybdenum between the noble-metal-alloy inclusions and the oxide matrix as measured using an electron microprobe. The values of the oxygen potential were found to be more negative than would be computed for the fuel on the basis of the initial O/M ratio, thus indicating that the overall O/M of the fuel was decreased by irradiation. The O/M gradient was computed and an oxygen material balance was determined between fuel oxide, fission products, and cladding. The nearly identical oxygen pressure profiles found for fuel pins irradiated for a range of values of the burnup indicates that the oxygen-potential gradient is established early in the irradiation period, probably at the time the structure is established and then remains nearly constant. The oxygen lost during the restructuring period is determined by the initial O/M of the fuel, smear density, and temperature gradient. The oxygen lost during the burnup period is proportional to the burnup. (4 tables, 6 figures, 24 references) (auth)

25033 NEUTRON-IRRADIATION-INDUCED VOIDS IN β-SILICON CARBIDE. Price, R. J. (Gulf General Atomic Co., San Diego, CA). J. Nucl. Mater.; 48: No. 1, 47-57(Aug 1973).

Pyrolytic β-silicon carbide was irradiated at temperatures between 625 and 1500°C to neutron fluences up to 12×10^{21} n/cm^2 (E > 0.18 MeV). Density changes were measured and the samples were examined by transmission electron microscopy. Irradiation below 1000°C created small Frank dislocation loops on {111} planes. Irradiation at 1250 and 1500°C produced tetrahedral voids which caused continuing expansion of the samples. Void sizes increased with increasing fluence and with increasing irradiation temperature, while void concentrations decreased with increasing temperature. One-hour post-irradiation anneals at 1700 to 2100°C reduced the void concentration and total void volume while increasing the maximum void size. (auth)

25034 METHODS OF REMOVING UNWANTED OXIDIZABLE SUBSTANCES FROM MATERIALS. Davies, T. A. (to United Kingdom Atomic Energy Authority). British Patent 1,321,699. 27 Jun 1973. Filed date 20 Nov 1970. 3p.

The method described is stated to be particularly suitable for the removal of unwanted oxidizable substances from nuclear fuel such as coated fuel particles. The material is placed in a closed furnace having two diametrically opposed openings. One of the openings is connected with a vessel containing a liquid that, in its vapor stage, oxidizes the unwanted substance. The furnace is operated to heat the material and evacuated by way of the other opening so as to promote boiling of the liquid and oxidation of the unwanted substance. The unwanted substance may be C in UO_2 fuel bodies and the liquid may be water. (UK)

25035 BOUNDARY PHASE STABILITY AND CRITICAL PHENOMENA IN HIGHER-ORDER SOLID-SOLUTION SYSTEMS. Rudy, E. (Oregon Graduate Center, Beaverton). J. Less-Common Metals; 33: No. 1, 43-70(Oct 1973).

The stability of double pseudobinary solid solutions with respect to phase separation was found to be dependent not only on the randomization energy, but also on the free energies of formation of the boundary phases. Phase separations in such systems may therefore also occur when the boundary solutions behave ideally. The conditions for stability and the binodal and spinodal surfaces are derived and applied to the alloy system Ti–Mo–C–N. Predictions are made for V–Mo–C–N and other carbonitride systems. The results are discussed and the thermodynamic considerations generalized to include higher order systems. Possible applications of this new phenomenon in alloy development and studies of phase phenomena in higher-order systems are outlined. (16 figures, 28 references) (auth)

25036 SEVERAL FORMS OF OXYGEN ADSORPTION ON MoO_3/Al_2O_3 FROM CALORIMETRIC AND EPR DATA. Aptekar, E. L.; Spiridonov, K. N.; Krylov, O. V.; Bykhovskii, M. Ya.; Lebedev, Yu. A.; Miroshnichenko, E. A. (Inst. of Chemical Physics, Moscow). Izv. Akad. Nauk SSSR, Ser. Khim.; No. 6, 1433(Jun 1973). (In Russian).

The concentration of the ion radical O_2^-, stabilized by Al^{3+}, was compared with the total quantity of chemisorbed oxygen and the heat of its adsorption in dependence on the concentration of Mo on the surface of γ-Al_2O_3 at 25°. The results led to the hypothesis that the first portion of the oxygen is adsorbed in the form of atoms on the reduced form of Mo. (JSR)

Metals and Alloys

Refer also to abstract 24949.

25037 THEORY OF METALS AND THE MANY-BODY PROBLEM. Vol. I. Acta Univ. Wratislaviensis; No. 181, 1-257(1972).

This is part of the IX Winter School of Theoretical Physics in Karpacz 1972. The eight papers, two of them in Russian, are on the effects of electron–phonon interaction on metallic properties, dielectric and magnetic response of an electron liquid, theory of positron annihilation in metals, zero sound and plasma oscillations in many-body systems, application of Fermi-liquid theory to metals, cubic anisotropy of effective quasielectron interaction in metals, electron theory of lattice properties of metals, and theory of galvanomagnetic effects. (DLC)

25038 THEORY OF METALS AND THE MANY-BODY PROBLEM. Vol. II. Acta Univ. Wratislaviensis; No. 181, 1-246(1972).

In this volume, nine lectures cover the following topics: electron spectroscopy of chemisorbed atoms, surfaces and chemisorption, singularities in the state density of quasiparticles (spin waves and excitons), many-body theory methods in studies of light absorption and dispersion by impurity centers, equation of state of ferromagnet near curie point, inelastic coherent scattering of slow neutrons by localized vibrations of substitutional and interstitial atoms, and metal–insulator transition and Lifshitz instability in the Hubbard model. (DLC)

25039 EVALUATION OF THE POTENTIALITIES OF NIOBIUM AND SUGGESTIONS FOR IMPROVING ITS MARKET. Krishnadev, M. R.; Galibois, A. (Laval Univ., Quebec). pp 581-586 of III Interamerican Conference on Materials Technology. Buenos Aires; Centro Regional de Ayuda Tecnica (1972).

From 3rd Inter-American conference on materials technology; Rio de Janeiro, Brazil (14 Aug 1972). See CONF-720832-.

Mineral resources of niobium, methods of producing ferroalloy, high-purity oxide, and the pure metal are reviewed. The state of art of niobium technology and trends in the usage of niobium are discussed. Proposals have been put forward for improving the market for niobium against the exploitation of pyrochlore deposits in Canada and Brazil. These proposals incorporate the use of a new type of plasma furnace for the production of high-purity niobium products. (40 references) (auth)

Corrosion and Erosion

Refer also to abstracts 24991, 26471, and 26531.

25040 (MLM-2055) EFFECTS OF IRON AND CHROMIUM FUEL IMPURITIES ON MOLYBDENUM AT 1500°C and 1700°C AND ON TANTALUM-10 WT % TUNGSTEN AT 1200°C. Teaney, P. E.; English, J. J. (Mound Lab., Miamisburg, Ohio). 24 Aug 1973. Contract AT-33-1-GEN-53. 29p. Dep. NTIS. $4.00.

A series of tests were conducted at 1500 and 1700°C with molybdenum and at 1200°C with tantalum-10 wt % tungsten in an attempt to determine the influence of fuel impurities on $^{238}PuO_2$–substrate reactions and to establish a level below which the effects of fuel impurities are insignificant. Special batches of fuel with seven fuel impurity compositions containing from 0.01 to 0.44 wt % each of iron and chromium were evaluated for various time periods. Results of the tests with molybdenum indicated that the presence of iron and chromium impurities in the fuel had little effect, except possibly retarding molybdenum mass transport with increasing impurity content. Intermetallic compounds rich in iron and chromium formed on the tantalum–10 wt % tungsten surface when the impurity content of the fuel was as low as 0.1 wt %. The thickness of the intermetallic layer was usually 12 μm or less for the impurity levels investigated. Lattice diffusion of iron and chromium into tantalum–10 wt % tungsten was usually limited to ~25 μm in 120 days at 1150 to 1200°C. Preferential grain-boundary diffusion of chromium was observed to exceed the lattice diffusion depth in localized regions of the specimens. (auth)

25041 (ORNL-TM-4221) FORCED-CIRCULATION LOOP FOR CORROSION STUDIES: HASTELLOY N COMPATIBILITY WITH $NaBF_4$–NaF (92-8 mole %). Koger, J. W. (Oak Ridge National Lab., Tenn.). Dec 1972. Contract W-7405-eng-26. 20p. Dep. NTIS $3.00.

A sophisticated pumped loop system was designed and operated to study the compatibility of Hastelloy N with flowing $NaBF_4$–NaF (92.8 mole %) at a maximum temperature of 620 and a minimum of 454°C. One unique feature of the design of this loop was the ability to remove or add corrosion test specimens without draining the fluid from the loop. Principal test variables included temperature, velocity, time, and impurities in the fluid. Measurements disclosed weight losses in hot-zone specimens, weight gains in cold-zone specimens, with a balance point (no gain or loss) at a temperature halfway between the maximum and minimum. Under certain conditions, larger weight losses and gains were found in specimens exposed to high-velocity salt. In time, mass transfer rates became much lower, and no velocity effect was noted. Specimen examination early in the life of the loop disclosed a definite downstream effect. The first specimen of three exposed to the salt (same temperature, same velocity for each specimen) showed the largest gain or loss, the next specimen showed the next largest change, and the last specimen showed the smallest change of the three. Overall average corrosion rate of the hottest specimen (620°C) was 0.94 mil/year at 20.8 fps and 0.74 mil/year at 10.9 fps. An average corrosion rate of 0.05 mil/year for the hottest specimen was found in one 1256-h increment. (auth)

25042 (ORNL-TM-4271) MASS TRANSFER BETWEEN HASTELLOY N AND A MOLTEN SODIUM FLUOROBORATE MIXTURE IN A THERMAL CONVECTION LOOP. Koger, J. W. (Oak Ridge National Lab., Tenn.). Dec 1972. Contract W-7405-eng-26. 23p. Dep. NTIS $3.25.

It was shown that temperature-gradient mass transfer occurred in a Hastelloy N thermal convection loop circulating a sodium fluoroborate–sodium fluoride mixture ($NaBF_4$–8 mole % NaF) at temperatures of 687°C maximum and 438°C minimum for 19,930 h. The maximum calculated corrosion rate (based on uniform removal) was 0.29 mil/year. Overall, the compatibility in this system was good. Impurities such as air inadvertently admitted to the loop system increased the mass transfer rate. Material (chromium, iron, and nickel) removal resulted in voids in the hot leg. Iron and nickel deposited in the cold section, but chromium ions remained in the salt. Some of the deposits in the cold leg appeared to have cubic symmetry. (auth)

25043 (ORNL-TM-4272) COMPATIBILITY OF BRAZING ALLOYS AND THE MOLTEN SALT $NaBF_4$–8 MOLE PERCENT NaF AT 610°C. Koger, J. W. (Oak Ridge National Lab., Tenn.). Dec 1972. Contract W-7405-eng-26. 44p. Dep. NTIS $4.25.

A comprehensive review of the compatibility of braze alloys with molten fluoride salts was performed. Eight different braze alloys, used to braze Hastelloy N, were exposed to $NaBF_4$–8 mole % NaF at 610°C for 4987 h. On the basis of weight changes, microstructural changes, and electron microprobe analysis, all alloys tested were compatible. The Ag–28% Cu and 100% Cu braze alloys were considered the most resistant. The prediction of corrosion resistance on the basis of free energy of formation data was in reasonable agreement with the results. Nickel transferred to non-nickel-containing braze alloys through an activity gradient mass transfer mechanism. Some deposits were noted on the Hastelloy N base material. Significant interdiffusion of the Hastelloy N and the braze alloy occurred only with those braze alloys whose composition was near that of Hastelloy N. (28 figures, 11 tables, 27 references) (auth)

25044 (ORNL-tr-2705) RESISTANCE OF AUSTENITIC STEEL IN CONTACT WITH LIQUID SODIUM DURING THERMAL CYCLING. Balandin, Yu. F.; Malgyin, A. F. Translated from Fiz. Khim. Mekh. Mater.; 8: No. 5, 57-59(1972). 5p. Dep. NTIS $3.00.

The effects of liquid sodium on the thermal fatigue resistance of Cr–Ni austenitic steels were studied. It was found that air and cooling water are relatively more aggressive media than liquid sodium with regard to thermal fatigue in these steels. The results obtained agree with literature data on the effects of sodium on high-temperature resistance to fatigue. (JRD)

25045 EFFECTS OF SURFACE TREATMENTS ON THE RATES OF OXIDATION OF URANIUM AT ROOM TEMPERATURE. Botros, B. M.; McIntyre, J. M. Technical Paper M72-238. Dearborn, MI; Society of Manufacturing Engineers (1972). 20p.

Experimental studies were conducted to determine the effects of various inorganic and organic treatments on the oxidation of U metal at room temperature, in the presence of a moist atmosphere of N and O. A special apparatus was built for that purpose with control of the corrosive atmosphere, temperature, and humidity, and with facilities to analyze the exit gases. Of the treatments studied, potassium chloride accelerated corrosion and the dibutyl phosphite and sodium oxalate treatments slowed the corrosion most effectively. It appeared that the metal preparation technique had the greatest influence on water and O corrosion of U. (Metals Abstr)

25046 EFFECT OF STRESS AND COLD WORK ON INTERGRANULAR STRESS CORROSION OF TYPE-304 STAINLESS STEEL IN SIMULATED REACTOR COOLANT. Pickett, A. E.; Sim, R. G. Paper No. 105. Houston, TX; National Association of Corrosion Engineers (1973). 16p.

Specimens of 304 stainless steel were annealed, cold rolled, machined, and heat treated at 621°C for 24 h. The susceptibility to intergranular stress-corrosion cracking was evaluated in an 0.2-ppM 0 simulated-reactor water test. Results were used to develop a model which predicts the time required for stress-corrosion cracks to propagate as a function of stress and cold work. The initiation time is shown to be zero when the applied stress equals the ultimate tensile stress. It then increases as the stress decreases until, at some reduced stress level, the initiation time tends toward infinity. This stress level occurs at ~80% of the yield stress for cold worked sensitized material in the range of 5 to 20% cold reduction and at 125% of the yield stress for annealed and sensitized material. Nonsensitized 304 stainless cold worked up to 20% is much more resistant to cracking as compared with the furnace-sensitized condition. (Metals Abstr)

25047 PERFORMANCE OF 304 STAINLESS STEEL STRUCTURAL COMPONENTS IN GENERAL ELECTRIC CO. BOILING WATER REACTORS. Walker, W. L.; Higgins, J. P. Paper No. 103. Houston, TX; National Association of Corrosion Engineers (1973). 7p.

Recent service failures in 304 stainless steel structural components used in boiling water reactors are reported. They include: intergranular stress-corrosion cracking near welds in piping under 8 in. in dia.; similar cracking in cold worked and subsequently severely sensitized components under normal service conditions; stress-corrosion cracking in severely sensitized nozzle transition pieces; mixed stress-corrosion cracking and transgranular fatigue cracking in mill-annealed, heavy wall piping; stress-corrosion cracking in radiation-hardened tightly creviced small fasteners; and transgranular chloride stress corrosion cracking on an external pipe surface. Factors which influence cracking are shown to include tensile stresses, thermal sensitization, and prior exposure to pickling in solutions containing fluoride ions. (Metals Abstr)

25048 REACTION OF HIGHLY REFRACTORY CERAMICS WITH VANADIUM. Tolstaya, V. Ya.; Efimov, Yu. V. (Ukrainian Scientific-Research Inst. of Refractories, Kharkov). Refractories (USSR) (Engl. Transl.); 13: No. 11-12, 740-743(1972).

Translated from Ogneupory; 13: No. 11, 51-55, Nov 1972.

Results of a study are presented on reactions of various high-temperature ceramics with vanadium and changes in its properties during smelting, as a function of the type of ceramic employed. The starting material consisted of electrolytic vanadium containing 0.0055% C, 0.011% N, 0.058% O, and 0.0005% H (total remaining impurities less than 0.1%). The lattice constant for vanadium equals 3.028 ± 0.001 Å, the microhardness 194 kg/mm², the hardness 78 HB, and the temperature of transition to the superconducting state (T_K) 5.3°K. Refractory ceramic crucibles of Al_2O_3, ZrO_2, $SrZrO_3$, $SrHfO_3$ were used. The crucibles of corundum and zirconia were prepared by the usual technology. The strontium zirconate and hafnate used for making the crucibles were synthesized from chemically pure materials (ZrO_2, HfO_2, and $SrCO_3$) by reaction in the solid phase at 1750°C. The crucibles made from synthetic materials were prepared by slip casting. The open porosity of the crucibles was 5 to 11%. Results of the studies are analyzed and presented in tables. (JRD)

25049 SUSCEPTIBILITY OF LOW-CARBON Cr–Ni STEEL TO INTERCRYSTALLINE CORROSION. Savkina, L. Ya.; Lazareva, N. A.; Fel'dgandler, E. G.; Agapova, N. P. Metal Sci. Heat Treat. (USSR) (Engl. Transl.); 15: No. 1-2, 147-149(1973).

Translated from Metalloved. Term. Obrab. Metal.; 15: No. 2, 55-57(Feb 1973).

The effects of C, Ni, Cr, Mo, W, and Nb on the susceptibility of Cr–Ni steel to intercrystalline corrosion (ICC) was investigated. Results show that Cr–Ni steel 000Kh16N20 is not susceptible to ICC with less than 0.008% C or with Nb/C ≥ 17. Alloying with about 2% molybdenum and tungsten reduces susceptibility to ICC. The steel is susceptible to ICC at higher temperatures. The higher the nickel content, the lower the permissible carbon content at which the steel is not susceptible to ICC. (JRD)

25050 CORROSION CHARACTERISTICS AND STRUCTURAL TRANSFORMATIONS IN ALLOY N70M27 WITH VANADIUM AND NIOBIUM. Svistunova, T. V.; Kirienko, V. I.; Potapov, L. P.; Runova, Z. K.; Smirnova, A. V. (Central Scientific-Research Inst.

of Ferrous Metallurgy, Moscow). Metal Sci. Heat Treat. (USSR) (Engl. Transl.); 15: No. 1-2, 124-130(1973).

Translated from Metalloved. Term. Obrab. Metal.; 15: No. 2, 33-39(Feb 1973).

Results of investigations concerning the effects of 1.8% and 2.0% Nb additions on the corrosion properties of Ni-base Mo alloys at 600 to 800°C are presented. It was found that the addition of V reduces the corrosion rate and eliminates intercrystalline corrosion under these conditions for 30 min. Similar behavior was noted after addition of Nb. The increase in corrosion resistance by addition of the individual elements is attributed to slowing of carbide formation and promotion of ordering. (JRD)

25051 TRENIYE I IZNOS MODIFITSIROVANNYKH METALLOV. (Friction and Wear of Modified Metals). Vinogradov, Yu. M. Moscow; Izdat'stvo Nauka (1972). 151p.

Methods of combating friction and wear of machine parts by chemical enrichment of the surface layers with sulfides, selenides, tellurides, and chlorides are described. Thermographic analysis is used to determine the most effective chemical compounds and processing temperatures and it is determined that in order to achieve a positive effect a chemical interaction between the modifying elements and the metal treated is necessary. Formulas are developed for salt baths for sulfiding, sulfocyaniding, seleniding, and telluriding. The structure of the modified surfaces is studied using chemical, x-ray-structural, electronographic, and metallographic analysis. The dependence is illustrated between various structural components of the modified layer and its wear resistance. Radioactive isotopes are used to study the kinetics of wear of modified surfaces in the process of friction. The existence of "regeneration" of the modified layer into the depth of the metal as the surface wears is established. The influence of surface modification of metals on friction and wear is studied under laboratory conditions on machines and under production conditions on various parts of machines. The boundaries of applicability of the method of modification and its effectiveness as functions of friction conditions are established. The experience gained in the application of methods of modification of metal surfaces in domestic and foreign practice in various branches of industry is described. Instructive materials are presented on the technology of modification of metal surfaces and the application of these processing methods. (246 references) (JPRS)

25052 INTERGRANULAR CORROSION IN IRON- AND NICKEL-BASE ALLOYS. Henthorne, M. (Carpenter Tech. Corp., Reading, PA). Amer. Soc. Test. Mater., Spec. Tech. Publ.; No. 516, 66-119(1972).

From symposium on localized corrosion-cause of metal fatigue; Atlantic City, New Jersey, USA (27 Jun 1971). See ASTM-STP-516; CONF-710666-.

Intergranular corrosion in stainless steels (austenitic, ferritic, and two phase) and nickel base corrosion resistant alloys (nickel–chromium–iron, nickel–chromium–molybdenum, and nickel–molybdenum) is reviewed. Practical aspects discussed include thermal treatments producing susceptibility, media that cause attack, influence of alloy composition, and prevention methods. The currently most plausible mechanisms are also outlined. Test methods, particularly the standard methods for quality control, are dealt with as well as techniques used to simulate the thermal effects of welding. The relationships between intergranular attack and other forms of localized corrosion are noted. (auth)

25053 CREVICE CORROSION OF SOME Ni–Cr–Mo–Fe ALLOYS IN LABORATORY TESTS. Jackson, R. P.; van Rooyen, D. (International Nickel Co., Inc., Suffern, NY). Amer. Soc. Test. Mater., Spec. Tech. Publ.; No. 516, 210-221(1972).

From symposium on localized corrosion-cause of metal fatigue; Atlantic City, New Jersey, USA (27 Jun 1971). See ASTM-STP-516; CONF-710666-.

Results were obtained for six alloys, evaluated in the laboratory for crevice corrosion resistance. Two methods were used: (1) direct observation of corrosion damage in several electrolytes and (2) electro-chemical determination of polarization curves. Results showed the ratings of the alloys in the order of decreasing resistance using both methods. In the direct crevice corrosion tests, it was found that the crevice size was important, especially for the more resistant alloys. Some scatter was found in those results. The polarization data provided more detail of corrosion behavior over a wide range of potential; therefore, the electrochemical test was considered a superior tool in alloy screening and development. Neither method, at present, can predict exact field performance. (auth)

25054 ELECTROCHEMICAL STUDIES OF TITANIUM IN MOLTEN SODIUM TETRAFLUOROBORATE. Clayton, F. R. (Univ. of Tennessee, Knoxville); Mamantov, G.; Manning, D. L. J. Electrochem. Soc.; 120: No. 9, 1199-1201(Sep 1973).

The electrochemical reduction of Ti(IV) in molten $NaBF_4$ at 420°C was studied by voltammetry, chronopotentiometry, and chronoamperometry. The process, Ti(IV) + e = Ti(III), at both platinum and pyrolytic graphite electrodes was found to be reversible. No further reduction steps were observed. A standard electrode potential for this couple of −0.358V (vs. a unit mole fraction Fe(II)/Fe electrode) was obtained. (auth)

25055 ELECTROCHEMICAL STUDIES OF TITANIUM IN MOLTEN FLUORIDES. Clayton, F. R. (Univ. of Tennessee, Knoxville); Mamantov, G.; Manning, D. L. J. Electrochem. Soc.; 120: No. 9, 1193-1199(Sep 1973).

The electrochemical reduction of Ti(IV) in molten LiF–NaF–KF [46.5–11.5–42.0 mole %] at 500°C was studied by means of linear sweep voltammetry, chronopotentiometry, and chronoamperometry. The reduction of Ti(IV) to Ti(III) was found to proceed reversibly at both platinum and pyrolytic graphite electrodes; further reduction of Ti(III) to the metal was shown to be a reversible process involving alloy formation with the platinum electrode. Standard electrode potentials for the processes, Ti(IV) + e = Ti(III) and Ti(III) + 3e = Ti, are −0.058 and −1.798V, respectively (both vs. a unit mole fraction Ni(II)/Ni electrode). The electrochemical oxidation of Ti(III) at unsheathed platinum and sheathed glassy carbon electrodes was studied in molten LiF–BeF_2–ZrF_4 (65.6–29.4–5.0 mole %) at 500°C. Evidence for a reversible electrode reaction was obtained from voltammetric and chronopotentiometric studies. A standard potential of +0.197V (vs. a unit mole fraction Ni(II)/Ni electrode) was determined for the process Ti(III) = Ti(IV) + e. The more anodic value of the standard potential of the Ti(IV)/Ti(III) couple in LiF–BeF_2–ZrF_4 in comparison with LiF–NaF–KF reflects the higher acidity (Lewis concept) of the LiF–BeF_2–ZrF_4 melt. (auth)

25056 CONTRASTING OF MICROSCOPIC OBJECTS IN A GAS-ION REACTION CHAMBER. Bartz, G. B. (Leitz E. GmbH, Wetzlar, Ger.). Prakt. Metallog.; 10: No. 6, 311-323(1973). (In German and English).

A contrasting method is introduced in which the polished specimen will be exposed in a vacuum chamber to a reactable partially ionized gas beam under simultaneous electron irradiation. In this way, thin layers will form on the polished surface, with interference colors of which can be assigned to chemically different phases of the material. The growth of the layer is observed in an instrument developed as a microscope attachment and will be stopped at the point of optimal contrast. (GE)

25057 LOCALIZED CORROSION; CAUSE OF METAL FAILURE. Seventy-Fourth Annual Meeting of the American Society for Testing and Materials, Atlantic City, NJ, June 27-July 2, 1971. ASTM Special Technical Publication 516. Philadelphia; American Society for Testing and Materials (1972). 327p. (ASTM-STP-516; CONF-710666-). $22.50.

Information and data presented at the symposium are included in fifteen papers. A separate abstract was prepared for each of two papers considered in the scope of NSA. (JRD)

For abstracts of individual papers see: 25052 and 25053.

25058 PROBLEMS OF MATERIALS USED FOR HIGH-TEMPERATURE HEAT PIPES. Busse, C. A. (Joint Nuclear Research Center, Ispra, Italy). Forsch. Ingenieurw.; 37: No. 2, 38-43(1971). (In German).

Two corrosion mechanisms with high-temperature heat pipes are known. The one mechanism is based on the solubility of the wall material in heat carriers and causes a mass transport from the cooling zone to the heating zone. The other mechanism involves the collecting of impurities in the heating zone, leading to an attack on the wall. The heating-zone corrosion can be removed by cleaning the heat pipe. For this the corrosion process itself can be used, e.g., the heating zone with the collected impurities can be separated and a part of the up-till-present cooling zone can be used as a new heating zone. The heating-zone corrosion can also be minimized by getter additions. In the temperature region of 1,500 to 2,000°C, a lifetime of 10,000 h seems possible; in one case, it was achieved. (GE)

25059 ELECTRICAL PROPERTIES OF NIOBIUM PENTOXIDE SCALES DURING THEIR FORMATION ON NIOBIUM. Sheasby, J. S. (Univ. of Western Ontario, London). Oxidation Metals; 6: No. 3, 145-156(Jun 1973).

A study of the electrical properties of compact scales growing on niobium revealed several new properties of the oxidation reaction. The growth of the oxide follows two parabolic rates, with the latter approximately four times the former. Both the rate constants and the time of transition between the rates are sensitive to oxygen pressure, but it is the latter property that largely explains the extreme sensitivity of the oxidation reaction to oxygen pressure reported previously. Concomitant with the change to the

faster oxidation rate is the development of a voltage across the scale (metal negative). The voltage has a value of 0.3 V at 1 atm and decreases approximately linearly with the logarithm of pressure to 0V at 10^{-3} atm. The oxidation rate is essentially insensitive to induced changes in the voltage. These properties of the oxidation reaction cannot be explained by the usual formalization of point defect theory. (9 figures, 14 references) (auth)

25060 TWENTY-YEAR INHIBITION OF CORROSION BY THE PERTECHNETATE ION. Cartledge, G. H. (Oak Ridge National Lab., TN). Corrosion; 29: No. 9, 361-362(Sep 1973).

Twenty years have elapsed since the discovery of the effectiveness of the pertechnetate ion in inhibiting the corrosion of iron and steel. In the meantime, numerous studies bearing on the mechanism of the action have been made. The results of certain of these studies are now applied to an interpretation of the behavior of a test specimen of carbon steel which remains unchanged after being exposed for twenty years in 5×10^{-4} F $KTcO_4$ containing 10 ppM of chloride ion at pH ~6, and with access of air. (12 references) (auth)

25061 ATMOSPHERIC CORROSION OF METALS. Rozenfeld, I. L. Houston, TX; National Association of Corrosion Engineers (1972). 237p.

This book considers atmospheric corrosion from the fundamental point of view. Accelerated corrosion in aggressive industrial environments are also considered. The seven chapters cover theory, mechanisms, atmosphere composition and climatic conditions, alloy composition, stability of various metals and alloys (Fe alloys, stainless steel, Ni–Fe alloys, Al alloys, Cu alloys, Zn, Mg, noble metals, etc.), corrosion under periodic wetting by electrolytes and condensation conditions, etc. A subject index is included. 224 references. (DLC)

25062 DEVELOPMENT OF OXIDATION-RESISTANT COATINGS FOR ZIRCONIUM ALLOYS. Roy, C.; Geschier, R.; Shui, R. (Univ. of Western Ontario, London). pp 223-228 of III Inter-american Conference on Materials Technology. Buenos Aires; Centro Regional de Ayuda Tecnica (1972).

From 3rd Inter-American conference on materials technology; Rio de Janeiro, Brazil (14 Aug 1972). See CONF-720832-.

A new approach to the problem of high-temperature protection of zirconium alloys to oxidizing environments is presented. It consists in forming a diffusion barrier at the surface of thermally grown ZrO_2 film by coating pre-oxidized samples of Zircaloy-2 with metallic layers, such as Al, Cu, Ni, Cr, Mo, and V, that strongly adhere to the oxide film. The interfacial reactions between the outer coatings and the ZrO_2 film that occur during vacuum anneals and/or oxidation, are characterized. The degree of protection provided by the coatings against oxidation of the metal substrate in the temperature range 500 to 600°C varies with both the type of coatings and the method of application. Some factors limiting the effectiveness of the coatings are specified. (auth)

25063 SODIUM–SULFATE-INDUCED RAPID OXIDATION OF A CHROMIUM–TITANIUM–SILICON COATING ON NIOBIUM ALLOY B-66. Whelan, E. P.; Trenouth, J. M. (National Research Council of Canada, Ottawa). J. Less-Common Metals; 33: No. 1, 153-170(Oct 1973).

The influence of Na_2SO_4 on the oxidation resistance of Cr–Ti–Si coatings on niobium alloy B-66 was studied. Specimens contaminated by Na_2SO_4 were oxidized at 1100, 1200, and 1300°C in air. Initial mass gains of contaminated specimens were considerably greater than those of uncontaminated specimens. The reaction initiating the accelerated oxidation appears to involve the accelerated dissociation of Na_2SO_4 by the oxides SiO_2, TiO_2, and Cr_2O_3, formed on the surface of the coating during oxidation. Subsequent to this dissociation a new, soft, oxide scale is formed that provides less oxidation protection to the underlying silicide zone than the original oxide scale, leading to the rapid oxidation of the coating, and to penetration of the subscale coating by interstitials. Some similarities between this work and studies of the hot corrosion of nickel and nickel-base superalloys are discussed. (14 figures, 30 references) (auth)

Preparation and Fabrication

Refer also to abstracts 24152, 24635, 26490, and 26564.

25064 (LA-UR-73-919) STRENGTHENING OF LIQUID SINTERED TUNGSTEN ALLOYS. Dickinson, J. M.; Riley, R. E.; Taub, J. M. (Los Alamos Scientific Lab., N. Mex.). 1972. 24p. (CONF-730718-1). Dep. NTIS $3.25.

From 4th international conference on powder metallurgy; Toronto, Canada (15 Jul 1973).

A rather large number of W-base liquid-phase alloys were made and studied. The high strength values, high densities, and high modulus values desired were obtained. Although the ductilities were generally good in compression, brittle failure was the rule in tension. Rhenium in particular had a strong strengthening effect. The high hardness and brittleness of the high Re content alloys can be explained by the sigma phase present in the matrix. While alloy matrix W alloys show promise, difficulty in obtaining small sizes of alloy powders having a good particle size distribution is a serious drawback. Tungsten alloys made with Co–Ni-plated W proved interesting. Good properties were obtained under carefully controlled sintering conditions to give a structure that appears to be a result of both solid and liquid phase sintering. (13 figures, 8 tables). (auth)

25065 (MLM-1350) ADHERENCE OF ION-PLATED AND VACUUM-DEPOSITED ALUMINUM FILMS. Wood, T. W. (Mound Lab., Miamisburg, Ohio). 2 Sep 1966. Contract AT(33-1)-Gen-53. 11p. Dep. NTIS $3.00.

Declassified 31 Oct 1972.

The adhesion of vacuum-deposited aluminum films to tantalum was studied. The deposition techniques of ion plating and vacuum evaporation were contrasted. Ion-plated films adhered excellently for all deposition temperatures, even –195°C. Films deposited by vacuum evaporation, however, adhered as well only with a deposition temperature of 400°C. The adhesion of vacuum-evaporated films at ambient and subambient deposition temperatures was very poor. The effects of various cleaning procedures on adhesion were contrasted. It was found that ion-bombardment cleaning of a heated substrate was the superior procedure. (auth)

25066 (ORO-3262-30) DUAL ANALYSIS OF LONGITUDINAL AND TRANSVERSE ZIRCONIUM TENSILE STRESS–STRAIN DATA. Garde, A. M.; Reed-Hill, R. E. (Florida Univ., Gainesville). 1973. Contract AT(40-1)-3262. 32p. (CONF-730822-2). Dep. NTIS $3.75.

From symposium on zirconium in nuclear applications; Portland, Oregon, USA (21 Aug 1973).

An analysis of zirconium tensile stress–strain data was made by the Crussard and Jaoul method and an analogous method based on the Swift equation $\epsilon_p = \epsilon_{p_0} + c\sigma^m$. Data from transverse and longitudinal specimens from 4 to 813°K were considered. Also investigated were the effects of a small prestrain at 77°K on the deformation behavior at 300°K, and the effects of composition on the deformation at an intermediate temperature (≃575°K). The two analyses revealed the same basic deformation stages in all specimens. Transverse and longitudinal specimens exhibited, in general, a different pattern of stages. At elevated temperatures (above 550 to 600°K) pure zirconium tends to exhibit single-stage behavior. Specimens in which kinking or twinning are significant factors showed multi-stage behavior. The basic pure zirconium stress–strain curve is one in which the stress–strain curve slope decreases rapidly with increasing stress. (2 tables, 10 figures, 26 references) (auth)

25067 (SCL-CR-720179) DEVELOPMENT OF TECHNOLOGY TO SHEAR SPIN VACUUM-HOT-PRESSED BERYLLIUM. Final Report. Sernka, R. P. (Philco-Ford Corp., Newport Beach, Calif. Aeronutronic Div.). Nov 1972. Contract 18-3352. 101p. Dep. NTIS $7.25.

For Sandia Labs., Livermore, CA.

The program was divided into three tasks: (1) feasibility demonstration of power shear spinning vacuum-hot-pressed beryllium, (2) development of technology to shear spin the cap-hat component, and (3) demonstration of shear spinning heavy-wall beryllium. Under task 1, 77% total reduction in wall thickness was achieved from the flat blank and 30% reduction was demonstrated in a single pass. Mechanical properties, crystallographic texture, and microstructural characterization were determined before and after shear spinning. Processing parameters such as forming temperature, rotational speed, forming roller axial feed rate, amount of deformation, forming roller configuration, and machine deflection allowance were determined. As a result of shear spinning to 67% reduction, beryllium exhibits an increase in basal plane crystallographic texture from 1.0 random to 5.0 random. The 67% reduction also causes an increase in longitudinal tensile properties of 34 and 25 KSI for yield and ultimate strengths, respectively. A method to shear spin the cap-hat configuration was devised, and two spun components were successfully made. A third cap hat was sectioned for mechanical and metallurgical evaluation. Processing parameters were established for the spinning operation, which involved forming a tapered wall dome integral with a 25° conical section. The conic portion was then free spun to essentially a cylinder. Tube spinning was then employed to reduce the wall thickness of the cylinder. Attempts to demonstrate the feasibility of shear spinning

beryllium from a 0.600 inch flat blank were largely unsuccessful. A recurring problem of cracking at the inside top corner of the cone frustum on the third and fourth spinning mandrels precluded achieving the objective of spinning a 7° half-angle cone. Possible causes of the problem and approaches to their solution were identified. (45 figures, 7 tables) (auth)

25068 (UCRL-13566) LANTHANUM ALLOY FOILS. (Research Chemicals, Phoenix, Ariz). Feb 1973. 32p. Dep. NTIS $3.75.

For California Univ., Livermore. Lawrence Livermore Lab.

Fabrication of 0.002-in. foils of La alloys containing 1 and 2 wt.% of Cr, Mg, or Sc was attempted. All were fabricable except La–1% Mg. (DLC)

25069 COMPACTING OF CARBIDE POWDER METAL PARTS. Wampler, H. B. Technical Paper EM-72-109. Dearborn, MI; Society of Manufacturing Engineers (1972). 9p.

Powder grades containing WC and Co vary in grain size, compressibility, and linear shrinkage rates and may contain pressing lubricants such as paraffin or starch. Methods of compacting include isostatic compacting, billet compacting, and pill pressing. Methods for eliminating press voids and cracks in pressed carbide parts are discussed. (Metals Abstr)

25070 RARE EARTH INTERMETALLIC COMPOUNDS BY A CALCIUM HYDRIDE REDUCTION-DIFFUSION PROCESS. Cech, R. E. (to General Electric Co.). U. S. Patent 3,748,193. 24 Jul 1973. Filed date 16 Aug 1971. 10p.

A reduction–diffusion process is described for producing novel rare-earth intermetallic compounds, for example, cobalt–rare earth intermetallic compounds, especially compounds useful in preparing permanent magnets. A particulate mixture of rare earth metal oxide, cobalt and calcium hydride is heated to effect reduction of the rare earth metal oxide and to diffuse the resulting rare earth metal into the cobalt to form the intermetallic compound. (Official Gazette)

25071 PURIFICATION OF BERYLLIUM. Seeley, F. G.; Crouse, D. J. Jr. (to United States Atomic Energy Commission). Australian Patent 426,197. 11 Jul 1972. Priority date 3 Oct 1967, United States of America (USA).

The invention is a method of selectively extracting beryllium values from an aqueous alkaline carbonate solution with an organic solution of a quaternary ammonium carbonate containing 39 to 75 carbon atoms and containing at least one methyl group attached to each nitrogen atom. (AEC)

25072 HEAT TREATMENT OF AUSTENITIC STEEL. Zackay, V. F.; Parker, E. R. (to United States Atomic Energy Commission). Australian Patent 424,350. 17 May 1972. Priority date 22 Nov 1966, United States of America (USA).

A process is described for making steel having both high strength and high elongation. Single-phase, austenitic steel, which has both M_S and M_D below ambient temperature, a total carbon plus nitrogen content of from about 0.2% to about 0.5% and which contains at least 0.5% of either molybdenum, chromium, manganese, vanadium, niobium, tantalum, or tungsten, is subjected to deformation at a temperature above about 650°F, but below the recrystallization temperature of the steel. (AEC)

25073 NICKEL–GERMANIUM–IRON BRAZING ALLOY. Fox, C. W.; Slaughter, G. M. (to United States Atomic Energy Commission). Australian Patent 426,218. 13 Jul 1972. Priority date 3 May 1967, United States of America (USA).

The alloy consists essentially by weight of 50 to 70% Ni, 20 to 30% Ge, 5 to 15% Fe, and at least one member of the group consisting of Cr and Si in the amounts of 5 to 10% and 2 to 5%, respectively. (Official Gazette)

25074 GRAIN REFINEMENT IN ALUMINIUM–ZIRCONIUM AND ALUMINIUM–TITANIUM ALLOYS BY METASTABLE PHASES. Ohashi, T.; Ichikawa, R. (Nagoya Inst. of Tech., Japan). Z. Metallk.; 64: No. 7, 517-521(1973).

Grain refinement in aluminum castings by Zr or Ti has been examined under various solidification conditions. Significant grain refinement takes place above a certain concentration of Zr or Ti where the shape of Al_3Zr or Al_3Ti primary turns petal-like. Both of them are very similar in shape to the metastable phase observed in the rapidly solidified Al–Zr or Al–Ti alloys. It is believed that the structure of the metastable phase in the Al–Ti alloys may be the same as that of the previously reported metastable Al_2Zr of Cu_3Au type. The lattice orientation relationships of these metastable phases are parallel with respect to the matrix of aluminium. It is suggested that the grain refinement in the peritectic composition alloys is due to the heterogeneous nucleation of aluminum by these metastable primaries. In the Al–Ti alloys, there is a discontinuity in the grain size reduction with Ti content and it is proposed that grain-refining mechanisms in alloys outside Al_3Ti primary field differs from that in alloys inside it. (GE)

25075 P/M IN GOVERNMENT PRODUCTS. Proceedings of the Second Tutorial Seminar, Detroit, Michigan, December 8–9, 1971. Progress in Powder Metallurgy, Volume 27, Part Two. New York; Metal Powder Industries Federation (1972). 134p. $20.00.

Developments in powder metallurgy (P/M) are reported in presentations on the status of P/M, sintered steel cams and gears, military potential of P/M products, production of P/M shapes, nondestructive testing of P/M parts, superalloy P/M, porous P/M meters and filters, iron P/M forging, and P/M friction devices and related articles. (JRD)

25076 GROWTH OF RARE EARTH–COBALT SINGLE CRYSTALS. Field, W. G.; Sampson, J. L. (Air Force Cambridge Research Labs., Bedford, MA). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 10, 603-607(1973).

From 18th annual conference on magnetism and magnetic materials; Denver, Colorado, USA (28 Nov 1972). See CONF-721114-P1.

Y_2Co_{17} and Ho_2Co_{17} are both congruently melting but due to their chemical reactivity and low surface tension are difficult to grow as single crystals. A unique crystal growth method based on thermal-imaging was used and is briefly described. This technique requires no crucible for Czochralski growth and can operate with any desired atmosphere. Single crystals of both materials were grown. These crystals are of sufficient size (8 by 30 mm) for essentially all magnetic measurements. Problems related to their growth are discussed and the growth parameters are given. Results of their evaluation are also presented. They include x-ray, electron-microprobe, and mass-spectrographic evaluations of crystalline perfection and purity. (auth)

25077 EXPERIMENTS IN THE LIQUID-PHASE SINTERING OF Sm_2Co_{17}. Carriker, R. C.; Rashidi, A. S. (Hamilton Metal Science, Lancaster, PA). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 10, 608-612(1973).

From 18th annual conference on magnetism and magnetic materials; Denver, Colorado, USA (28 Nov 1972). See CONF-721114-P1.

An initial investigation of the liquid-phase sintering of Sm_2Co_{17} using a 60 wt % Sm–40 wt % Co sintering aid was conducted. The total samarium content was varied from 25.3 to 34.5 wt % through sintering aid additions, with the resulting phases present in the sintered magnets being uncertain. The sintering temperature was varied from 1110 to 1140°C for a sintering time of 30 minutes. With the exception of the saturation induction, B_s, which decreased approximately 20%, the magnetic properties increased with increasing samarium content. This was particularly true of the intrinsic coercive force, H_{ci}, which increased as much as eighteenfold, while the coercive force, H_c, and the energy product, $(BH)_{max}$, each increased approximately sixfold. The residual induction, B_r, also increased, but only by approximately 20%. The best initial results yielded a magnet with the following properties: B_r = 6.0 kG, H_c = 3.8 kOe, H_{ci} = 9.0 kOe, and $(BH)_{max}$ = 6.4 MGOe. (auth)

25078 INVESTIGATION OF VARIABLES IN THE MANUFACTURE OF Pr–Sm–Co MAGNETS. Carriker, R. C. (Hamilton Metal Science, Lancaster, PA). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 10, 633-637(1973).

From 18th annual conference on magnetism and magnetic materials; Denver, Colorado, USA (28 Nov 1972). See CONF-721114-P1.

A study was undertaken to examine various processing parameters in the manufacture of $(Pr_xSm_{1-x})Co_5$ magnets. Parameters studied included the samarium-to-praseodymium ratio, sintering temperature and time, and aligning and compacting conditions. All of the alloys studied were nominally 63 wt % cobalt, with the total rare earth content being on the order of 37 wt %. Compositional variations which were investigated included: 20.7 wt % Pr–16.3 wt % Sm, 20.7 wt % Pr–15.8 wt % Sm, 20.35 wt % Pr–16.30 wt % Sm, 24.67 wt % Pr–12.33 wt % Sm, and 27.75 wt % Pr–9.25 wt % Sm. Sintering temperatures were varied over the range of 1085 to 1140°C, while the sintering times were either 30 or 60 minutes. Alignment fields of 10 kOe and 36 kOe were used and compacting was performed by either uniaxially pressing in a die or by isostatic pressing. Although the best magnet produced in the course of this investigation had an energy product of 22.6 MGOe, a possibly more significant result was that a magnet with an energy product of 19.4 MGOe was produced using uniaxial die pressing and an alignment field of only 10 kOe applied in the direction of pressing. (auth)

25079 MANUFACTURE OF RARE EARTH–COBALT MAGNETS. Weihrauch, P. F.; Paladino, A. E.; Das, D. K.; Reid, W. R.; Lesensky, L.; Wettstein, E. C.; Gale, A. A. (Raytheon Co., Wal-

tham, MA). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 10, 638-642 (1973).

From 18th annual conference on magnetism and magnetic materials; Denver, Colorado, USA (28 Nov 1972). See CONF-721114-P1.

High-performance rare earth–cobalt permanent magnets are being incorporated in an increasing number of devices. The translation of laboratory powder metallurgical processes into methods of volume manufacturing is described using $SmCo_5$–Sm_2Co_7. The crucial nature of each processing step is considered and the relationship to the intrinsic magnetic properties, property uniformity, and performance characteristics of finished magnets is discussed. (auth)

25080 IMPACT OF SOLIDIFICATION RESEARCH ON METALS PROCESSING. Brody, H. D. (Univ. of Pittsburgh). pp 461-470 of III Interamerican Conference on Materials Technology. Buenos Aires; Centro Regional de Ayuda Tecnica (1972).

From 3rd Inter-American conference on materials technology; Rio de Janeiro, Brazil (14 Aug 1972). See CONF-720832-.

Two major fundamental concepts of the solidification process are reviewed briefly and the recent efforts to develop new casting techniques based on these models are mentioned. One major concept describing the conditions to maintain a plane front interface provided the background for growth of metal single crystals and low defect semiconductor materials. Recent efforts have resulted in the growth from the melt of composite materials and transparent ceramics. The second major concept describing the morphology and solute redistribution in the dendritic freezing of alloys has led to a better understanding of microsegregation, macrosegregation, inclusions and grain structure; and provided background for the growth of single dendrites, unidirectional ingots and shaped castings, and premium quality casting, and for improvements in continuous casting and vacuum arc casting processes. Alloys for which data are given are Nb–Nb_2C, Ti–Mo, and binary Ti alloys. 17 figures, 10 references. (auth)

Properties, Structure, and Phase Studies

Refer also to abstracts 24952, 24983, 24985, 26041, 26090, 26161, 26195, 26214, 26472, 26489, 26501, 26662, and 26903.

25081 (AD-760461) EFFECT OF HEAT TREATMENT ON THE MECHANICAL PROPERTIES OF THE ALLOY Ti–8Al–1Mo–1V. Fopiano, P. J.; Hickey, C. F. Jr. (Army Materials and Mechanics Research Center, Watertown, Mass.). Apr 1973. 17p. (AMMRC-TR-73-17). NTIS.

The effect of heat treatment on the mechanical properties of the alloy Ti–8Al–1Mo–1V was investigated for solution temperatures from 1400 to 1900°F. Significant increases in strength can be obtained by selected solution and aging heat treatments. A critical temperature range for this alloy is observed to be 1550 to 1700°F where a yield strength minimum and ductility and toughness maximums were found. X-ray and replica electron microscopic studies were also conducted. A detailed discussion of the results and observations is presented. (NTIS)

25082 (AD-761215) MODIFICATION AND CONTROL OF OXIDE STRUCTURES ON METALS AND ALLOYS: (PHASE III). Final Report, 20 December 1971–20 January 1973. Svedberg, R. C. (Westinghouse Electric Corp., Pittsburgh, PA. Astronuclear Lab.). Feb 1973. Contract N00019-72-C-0132. 198p. (WANL-M-FR-73-3). NTIS.

The rutile structure family for oxide compounds of the type $Nb(B)O_4$ where B = Cr, Al, or Fe have been identified as being the primary oxide phase in the scales formed on oxidation-resistant Nb intermetallic compounds and Nb–Ti–Cr–Al, Nb–Fe–Al, Nb–Cr–Al–Co, and Nb–Cr–Al–Ni alloys. Along with this oxide, small amounts of either $(B)_2O_3$ where B = Cr, Al, or Fe or a $CoAl_2O_4$ spinel in cobalt containing alloys were detected. Oxygen transport rates through Nb_2O_3–Cr_2O_3, Nb_2O_5–TiO_2, Nb_2O_5–ZrO_2, and Nb_2O_5–Al_2O_3 were also determined using thermogravimetric techniques. Of the oxide compounds evaluated, only oxygen transport through Nb_3O_8–Cr_2O_3 was slow enough to warrant its classification as a protective scale. In addition to oxidation rate data, metallographic studies and electron microprobe studies are reported for the Nb intermetallic compounds and alloys. (NTIS)

25083 (BMFT-FBK-73-18) THERMODYNAMICS OF METAL–HYDROGEN REACTIONS AND STUDY OF THE URANIUM–HYDROGEN SYSTEM. Meusemann, H.; von Erichsen, L. (Bonn Univ. (West Germany). Institut fuer Physikalische Chemie). Jul 1973. 236p. (In German). Dep. NTIS (U.S. Sales Only) $14.00.

A survey is given for the metal hydrides on how to derive the characteristic thermodynamic functions from measurements of the thermodynamic equilibrium. Owing to the nonstoichiometry of most hydrides, there are some difficulties in formulating the exact equation of a given reaction system; thus, special and careful consideration should be given to the phase relations. From this viewpoint, particularly the thermodynamic and kinetic data of the numerous investigations of the uranium–hydrogen system summarized are critically discussed and completed by confirming measurements on the influence of uranium oxides and nitrides. (auth)

25084 (COO-3158-21) FIELD-ION-MICROSCOPE OBSERVATIONS OF THE THREE-FOLD SYMMETRIC DISSOCIATION OF $\frac{1}{2}a\langle 111\rangle$ SCREW DISLOCATIONS IN MOLYBDENUM. Seidman, D. N.; Burke, J. J. (Cornell Univ., Ithaca, N. Y. Materials Science Center). 5 Jul 1973. 44p. Dep. NTIS $4.25.

A field ion microscope (FIM) study was performed of the dislocation structure that exists in the $\{222\}$ planes and environs of both low- and high-purity molybdenum specimens. The dislocation structure always consisted of three-fold symmetric dissociated $\frac{1}{2}a\langle 111\rangle$ screw dislocations that emerged normal to the $\{222\}$ planes. Employing the pulsed-field evaporation technique, it was found that the dissociated dislocation structure consisted of a $ka\langle 111\rangle$ type partial screw dislocation (where k is a constant) that emerged normal to the $\{222\}$ planes and three stacking faults on the $\{110\}$ planes that intersected one another along a $\langle 111\rangle$ type direction. The three stacking faults exhibited three-fold symmetry about the $\langle 111\rangle$ type vector. This represents the first experimental observation of a three-fold symmetric dissociated $\frac{1}{2}a\langle 111\rangle$ screw dislocation in any bcc metal. The dislocation structure was produced in-situ in the FIM specimen at a specimen temperature of less than 50°K as a result of the molybdenum specimens yielding to electric-field-induced shear stresses greater than approximately 4.5×10^{10} dyne cm^{-2}. It is emphasized that continuous and extensive field evaporation of the specimens never removed this same basic dislocation structure. Simple arguments are presented to show that the observed dissociation could not have been caused by Suzuki segregation effects. (auth)

25085 (HSSTP-TR-23) HEAVY SECTION STEEL TECHNOLOGY PROGRAM TESTS OF 6-INCH-THICK TENSILE SPECIMENS FOURTH TECHNICAL SUMMARY REPORT. Tests of 1-inch-thick Flawed Tensile Specimens for Size Effect Evaluation. Grigory, S. C. (Southwest Research Inst., San Antonio, Tex.). Jun 1973. Contract W-7405-eng-26. 113p. Dep. NTIS $7.75.

For Oak Ridge National Lab., TN.

Results are presented of tests on 1-inch-thick specimens of A533B steel specimens geometrically similar to the large 6-inch-thick specimens. Test procedures and notch sharpening methods are summarized. The data and information are presented in sections and appendixes on test facility and specimen design, instrumentation and test results, clip gage data, strain data, and strain data from x–y plotter. (JRD)

25086 (IS-T-605) SOME LOW-TEMPERATURE PROPERTIES OF CERIUM. Koskimaki, D. C. (Ames Lab., Iowa). Sep 1973. Contract W-7405-eng-82. 92p. Dep. NTIS $6.75.

Thesis.

The two low-temperature allotropes of cerium (α and β) were prepared in their pure forms, and their low-temperature heat capacity and magnetic susceptibility were measured. The α phase is an essentially temperature-independent paramagnet with a minimum susceptibility of 3.77×10^{-6} emu/gram at 50°K. The electronic specific heat constant of this phase is 12.8 ± 0.2 mJ $g\text{-atom}^{-1}$ $°K^{-1}$ and the Debye temperature at zero degrees is 179 ± 2°K. The susceptibility of the β phase conforms to a Curie–Weiss paramagnetic behavior with an effective magnetic moment per atom of 2.62 μ_B, compared to the theoretical value for a free Ce^{3+} ion of 2.54 μ_B. The susceptibility deviates from this behavior below 120°K due to crystal field splitting. Specific heat measurements show that this phase undergoes a double antiferromagnetic ordering at 12.45 and 13.7°K, corresponding to separate ordering for the two types of site symmetry in β cerium. (17 figures, 10 tables, 64 references) (auth)

25087 (LA-5319) LATTICE PARAMETERS OF THE TERNARY DELTA PHASES Pu–Ga–Al AND Pu–Ga–Zr. Ellinger, F. H.; Gibbs, M.; Vigil, P. (Los Alamos Scientific Lab., N. Mex.). Aug 1973. Contract W-7405-eng-36. 4p. Dep. NTIS $4.00.

Measurements of the lattice parameters of Pu–Ga–Al and Pu–Ga–Zr delta-plutonium solid solutions suggest that considerable interaction occurs between the solutes, especially Ga–Zr, in these ternary alloys. Isoparametric surfaces and solubility limits at 500°C are reported. (auth)

25088 (LBL-1833) INFLUENCE OF SOME MICROSTRUCTURAL FEATURES ON THE FRACTURE TOUGHNESS OF HIGH-STRENGTH STEELS. Zackay, V. F.; Parker, E. R.; Wood, W. E. (California Univ., Berkeley. Lawrence Berkeley Lab.). May

1973. Contract W-7405-eng-48. 14p. (CONF-730806-3). Dep. NTIS $3.00.

From 3rd international conference on the strength of metals and alloys; Cambridge, UK (20 Aug 1973).

Relatively small amounts of embrittling microconstituents, often detectable only by a combination of careful optical microscopy and high-resolution electron microscopy, have a considerable influence on the fracture toughness of ultrahigh-strength steels. These embrittling microconstituents are commonly found in conventionally heat-treated steels. Devising heat-treating procedures to eliminate the undesirable microstructural features is an important aspect in the design of steels with improved fracture toughness. Methods of detecting undesirable microconstituents by various metallographic techniques and methods of eliminating or minimizing the effects of such constituents using appropriate heat treatments are described. Undissolved carbides are the prime cause of low plane strain fracture toughness of a 5 Mo, 0.3 C steel. Their subsequent elimination by the use of high austenitizing temperature results in a twofold increase in toughness. In AISI 4130 steel, conventionally used austenitizing treatments result in the formation of a large amount of free ferrite, which considerably lowers fracture toughness. Minimizing the amount of free ferrite by the use of higher austenitizing temperatures and more rapid quenches than those conventionally used results in a significant enhancement of fracture toughness. The superior fracture toughness of AISI 4340 steel austenitized at higher than conventionally employed temperatures is attributed to the presence of small amounts of retained austenite between martensite laths. It is concluded that, in low- and medium-alloy steels, unusual combinations of strength and toughness, comparable to those of the 18 Ni maraging alloys and approaching those of TRIP steels, can be attained. (auth)

25089 (UCRL-13572) SUPERPLASTIC DEFORMATION AND HIGH-TEMPERATURE CREEP OF A MONOTECTOID-COMPOSITION URANIUM-BASE ALLOY. Bly, D. L. (Stanford Univ., Calif. (USA). Dept. of Materials Science and Engineering). Apr 1973. 182p. (SU-DMS-73-T-52). Dep. NTIS $11.25.

Thesis.

The elevated-temperature creep properties of U–7.5 wt.% Nb–2.5 wt.% Zr were studied as a function of microstructure. The alloy exists as a single γ phase above 637°C and transforms to a two-phase structure ($\alpha + \gamma_1$) below 637°C. Thermomechanical processing techniques were used to achieve a fine-grain equiaxed $\alpha + \gamma_1$ microstructure, and creep deformation was carried out on the fine-grain equiaxed $\alpha + \gamma_1$ structure and the coarse-grain γ structure. Deformation behavior was studied using tension and compression tests at 500 to 1000°C. Deformation-enhanced spheroidization was used to produce a fine-grain equiaxed microstructure from the lamellar $\alpha + \gamma_1$ structure formed by isothermal transformation. The spheroidization kinetics were slower than in a eutectoid Fe–C alloy at the same homologous temperature and strain rate. Although incomplete spheroidization was observed after strains as large as $\epsilon = 1.9$, the results were in qualitative agreement with spheroidization mechanisms for steels. A fine-grain equiaxed $\alpha + \gamma_1$ structure can be most efficiently produced by employing a quench-cold work-anneal treatment before hot working. An equiaxed structure with a 0.5 μm grain size was produced by gamma quenching, cold working to $\epsilon = 0.5$, annealing at 550°C for 24 h, and hot working at 600°C to $\epsilon = 1.5$ (total strain). The equiaxed $\alpha + \gamma_1$ structure with a stable 1.7 μm grain diameter was superplastic only at temperatures immediately below the monotectoid temperature. At 635°C, maximum elongations were about 550%. Superplastic creep was described by $\dot{\gamma}$ k T/D_B G b) = 485 (b/d)^2 (τ/G)^2, where $\dot{\gamma}$ is the shear strain rate, D_B is the grain boundary diffusion coefficient, G is the shear modulus, b is Burgers vector, d is the grain diameter, and τ is the shear stress. At high stresses where $\tau/G > 10^{-3}$, there was a transition from superplastic creep to dislocation climb-controlled creep where the stress exponent is 5. Creep data at 550 to 600°C were in this transition range centered at $\tau/G \cong 10^{-3}$, while data at 500 to 525°C exhibited only five-power creep. The diffusion coefficient in the γ_1 phase was strongly temperature-sensitive. An apparent activation energy for lattice diffusion at equilibrium γ_1 composition was calculated to be 130 kcal/mole between 500 and 625°C, in good agreement with 123 kcal/mole from creep data at 513 to 613°C. Therefore, in the dislocation climb region and the transition region, creep is believed to be controlled by lattice diffusion. The creep activation energy at 631°C was about 60 kcal/mole, which was related to grain boundary diffusion and is consistent with superplastic creep behavior. When annealed to form a single γ phase with a 40 μm grain size, the alloy deformed by a viscous glide creep mechanism during initial straining ($\epsilon = 0.01$) at 670 to 1000°C. The creep equation was found to be ($\dot{\gamma}$ k T/D_L G b) = 11 (τ/G)^3, where D_L is the lattice diffusion coefficient. Power law breakdown was found to occur at $\tau/G \cong 2 \times 10^{-3}$. Structural changes occurred during deformation at 670 to 1000°C. At stresses less than about 1600 psi, hardening was observed which was related to subgrain formation and grain growth. At stresses greater than about 1600 psi, softening occurred, related to the formation of small recrystallized grains at grain boundaries, the probable mechanism being a grain boundary shear and migration process. Subgrains formed during deformation at all temperatures, especially near grain boundaries. (auth)

25090 (WARD-NA-3045-5) SELF-WELDING EVALUATION FOR A286 AND TYPE 304 STAINLESS STEEL IN FLOWING SODIUM AT 800°F. Chang, J. Y.; Flagella, P. N.; Schrock, S. L. (Westinghouse Electric Corp., Madison, Pa. Advanced Reactors Div.). Sep 1973. Contract AT(11-1)-3045. 29p. AT.

A program to evaluate the self-welding tendencies is described for specific FFTF components and material combinations at the expected conditions of compressive load and temperature for a six-month period in a flowing, high purity, ΔT, sodium system. No self-welding tendencies were detected for Type 304 Stainless Steel plate on Type 304 Stainless Steel plate and Type 304 Stainless Steel bar on A286 bar after exposure at 800°F in flowing sodium for six months. The 304/304 Stainless Steel material combination was evaluated at static compressive stresses of 2, 10, and 30 ksi, and the Type 304 Stainless Steel/A286 material combination at 15 and 30 ksi. Since the surfaces of the materials were preconditioned in the high purity sodium prior to contacting, and wiping was performed prior to applying the static compressive stress, conditions conducive to possible self welding were near the maximum. The results, therefore, strongly indicate that the FFTF components simulated should not encounter self-welding. Both material combinations tested, when subjected to 30 ksi compressive stress at 800°F for six months, exhibited detectable amounts of plastic deformation based on surface texture measurements after test. Although not analyzed in terms of the mechanical properties of the materials, it is probably related to the short-term tensile properties rather than creep, since creep is not significant at 800°F for the materials involved. As a result of the wiping operation performed for each sample pair at 800°F in sodium, prior to initiating the self welding evaluation, sliding friction coefficients were obtained, and the results correlated with the waviness height measurements for the surfaces and the applied compressive stresses to give: (WH/σ) = 0.008e^{3f}. This represents a relationship for initial sliding friction since the effects of time or distance of travel were not investigated. (auth)

25091 (Y-DA-5284) X-RAY DIFFRACTION RESIDUAL STRESS ANALYSIS USING HIGH-PRECISION CENTROID-SHIFT MEASUREMENT TECHNIQUES: APPLICATION TO URANIUM–0.75 WEIGHT PERCENT TITANIUM ALLOY. Baucum, W. E.; Ammons, A. M. (Oak Ridge Y-12 Plant, Tenn. (USA)). 26 Jul 1973. Contract W-7405-eng-26. 12p. (CONF-730830-1). Dep. NTIS $3.00.

The standard three-point parabola technique has been used extensively in residual stress analysis for peak location with precisions (standard deviation) of peak shift measurements in the range of 0.01 to 0.03° (2θ), where θ is the diffraction angle. While this level of precision produces useful data for peaks at high diffraction angles, it becomes untenable when a material with high elastic modulus is encountered whose only suitable peak falls below approximately 140° 2θ. Uranium–0.75 wt. % titanium alloy, the material of interest in this investigation, falls into this category. A technique has been developed by which diffraction-peak centroid shifts are determined with a precision of 0.002° of diffraction angle ($\Delta 2\theta$). The method consists of step-scanning over the peak of interest to acquire data in digital form. A small computer is then used to locate the diffraction line by calculating its centroid from digital data. The use of a special probe consisting of four distance transducers (LVDT) to achieve precise alignment of the specimen surface on a Siemens back-reflection stress diffractometer is also described. A calibration experiment was performed on uranium–0.75 titanium tensile specimens in which the x-ray-diffraction response was measured as a function of various levels of applied stress in order to determine the experimental elastic moduli. It was found that repetitive analysis on a single area of a cylinder had a standard deviation on the measured diffraction centroid shift of 0.002 degree, which is approximately an order of magnitude smaller than that achieved by the standard parabola fitting technique. Thus, the residual stress can be defined to a precision of ~2,000 psi, as opposed to 30,000 psi, at best, were the measurements obtained by the conventional procedure. (auth)

25092 SOME REGULARITIES OF STRUCTURE IN PHASE DIAGRAMS OF SYSTEMS OF TRANSITION METALS OF GROUPS III TO VI. Upadkhaya, G. Sh. pp 116-123 of Metallidy: Stroenie,

Svoistva, Primenenie. Kornilov, I. I. (ed.). Moscow; Izdatel'stvo Nauka (1971). (In Russian)

The possibility of explaining the formation of one or another type of binary diagram during interaction of transition metals was examined from the viewpoint of the electronic structure of the atoms of the components. The experimentally confirmed ideas on the distribution of valence electrons of isolated atoms (during formation of the condensed state) on the localized (on the framework of the atom) and nonlocalized (collective) parts were taken as the basis. The greatest statistical weight of the atom in the crystals of transition metals correspond to the energetics of the most stable configurations of the localized part of the d^5 and f^7 electrons. As an example, binary systems of the transition metals of the groups III to VI were examined. Theoretically it was indicated that from the size and difference of the statistical weights of the atoms with stable configurations of the components depend the character of the interaction and the type of phase diagram. (tr-auth)

25093 SOME PHYSICAL PROPERTIES OF GERMANIDES OF TRANSITION METALS OF GROUPS IV TO VI. Grechko, O. G.; L'vov, S. N.; Vondarev, V. N. pp 142-149 of Metallidy: Stroenie, Svoistva, Primenenie. Kornilov, I. I. (ed.). Moscow; Izdatel'stvo Nauka (1971). (In Russian)

The magnetic susceptibility, specific electrical resistance, Hall coefficient, thermoelectromotive force, and microhardness of almost all known germanide phases of the transition metals of groups IV to VI (27 phases) were determined at room temperature. The germanides were prepared by the sintering of preextruded mixtures of stoichiometric composition in quartz evacuated ampules in furnaces filled with purified argon with excess pressure. From the compounds, prepared compact samples were prepared by the method of hot extrusion. The specific electrical resistance of the germanides with relatively small concentrations of germanium per atom of transition metal often exceeds the specific electrical resistance of the same metals and higher phases. The paramagnetic susceptibility, calculated on gram-atom of the metal in the compound, is increased much less than in the same metals. Many germanides are diamagnetic. The microhardness of the lower germanides is higher than the original metal and is reduced during transition to the digermanides. The values obtained of the electrical conductivity, Hall coefficient, and thermoelectromotive force indicates that the examined compounds as well as the borides, carbides, nitrides, and silicides have an electrical conductivity of the metallic compound electron hole character. (tr-auth)

25094 MEASUREMENT OF PHYSICAL PROPERTIES. Part 1. Some Special Properties. Passaglia, E. (ed.). Techniques of Metal Research, Volume VI. New York; John Wiley and Sons, Inc. (1972). 501p.

The six chapters cover: theory and measurement of thermal radiation properties of metals; thermionic emission and work function; electronic density of states and low-temperature (1 to 20°K) specific heats of metals; ion-neutralization spectroscopy; microwave resonances in metals; and photoemission spectroscopy of metals. (DLC)

25095 ACTIVATION ENERGY FOR CREEP OF COLUMBIUM (NIOBIUM). Klein, M. J.; Gulden, M. E. (International Harvester Co., San Diego, CA). Met. Trans.; 4: No. 9, 2175-2180(Sep 1973).

The activation energy for creep of nominally pure niobium was determined in the temperature range 0.4 to 0.75 T_M by measuring strain-rate changes induced by temperature shifts at constant stress. A peak in the activation energy vs temperature curve was found with a maximum value of 160 kcal/mole (672 kJ/mole). A pretest heat treatment of 3000°F for 30 min resulted in even higher values of activation energy (>600 kcal/mole, 2520 kJ/mole) in this temperature range. The activation energy for the heat-treated Nb could not be determined near 0.5 T_M because of unusual creep curves involving negligible steady-state creep rates and failure at <5% creep strain. It is suggested that the anomalous activation energy values and the unusual creep behavior in this temperature range are caused by dynamic strain aging involving substitutional atom impurities and that this type of strain aging may be in part responsible for the scatter in previously reported values of activation energy for creep of Nb near 0.5 T_M. (auth)

25096 EXCEPTIONAL HARDNESS AND CORROSION RESISTANCE OF Mo_5Ru_3 AND W_3Ru_2 FILMS. Testardi, L. R.; Royer, W. A.; Bacon, D. D.; Storm, A. R.; Wernick, J. H. (Bell Telephone Labs., Murray Hill, NJ). Met. Trans.; 4: No. 9, 2195-2198(Sep 1973).

Films of Mo_5Ru_3 and W_3Ru_2 prepared by sputtering on hot sapphire substrates exhibit interesting properties. The films are among the hardest known electrical conductors and show Knoop hardness values comparable to sapphire. They exhibit high resistance to most common etchants (particularly acid etchants), have high scratch resistance, and have excellent adhesion to the (sapphire) substrates. The temperature coefficient of electrical resistivity can be made either negative, positive, or zero by varying the substrate deposition temperature. Reflectivity measurements from ultraviolet to infrared are also reported to assess their possible use as reflecting surfaces. (auth)

25097 KINETICS OF GAS ABSORPTION BY REFRACTORY METALS IN DISSOCIATED ENVIRONMENTS: THE NITROGEN/TANTALUM SYSTEM. Rosner, D. E.; Steinheil, E.; McArthur, D. P. (Yale Univ., New Haven). Met. Trans.; 4: No. 9, 2221-2222(Sep 1973).

Kinetic aspects of atomic N absorption by Ta at 1750 to 3000°K were studied. It is noted that the absorption rates for N by Ta can exceed those for N_2 by a large margin and that the steady-state dissolved gas concentrations are higher for Ta exposed to nonequilibrium N than to an equal pressure of N_2. Test results are presented graphically and used as a basis for a conclusion that values for the dimensionless absorption probability (α) should be identifiable with the corresponding low-coverage chemisorption probabilities. (JRD)

25098 EFFECT OF HYDROGEN, ALCOHOLS, AND MOISTURE ON THE ULTIMATE TENSILE STRENGTH AND ELECTRIC RESISTANCE OF TUNGSTEN- AND STEEL-WIRE SPECIMENS. Vasilenko, I. I.; Loboiko, V. I.; Mikitishin, S. I.; Chaplya, O. N. (Physical-Mechanical Inst., Lvov). Fiz.-Khim. Mekh. Mater.; 9: No. 3, 3-8(1973). (In Russian).

The effects of H_2, O_2, H_2O, He, C_6H_{14}, C_2H_5OH, and atmospheric media on the ultimate tensile strength and electric resistance of steel and tungsten wires were studied. The nature of the interaction of these media with the metals is explained. Kinetic curves of the change of the electric resistance in the processes of sorption and desorption were obtained. These curves indicate the reversibility and irreversibility of the adsorption of the molecule. A correlation was established between the change of the ultimate tensile strength and the electric resistance of steel and tungsten during adsorption of the media on its surface. The role of water and the change of the electric resistance during testing in air is shown. (tr-auth)

25099 POSSIBILITY OF PREDETERMINATION OF EPURES OF RESIDUAL STRESSES IN BORONIZED STEELS. Lyakhovich, L. S.; Kosachevskii, L. N.; Kulik, A. Ya.; Surkov, V. V.; Turov, Yu. V. (Belorussian Polytechnic Inst., Minsk). Fiz.-Khim. Mekh. Mater.; 9: No. 3, 34-37(1973). (In Russian).

With consideration of the coefficients of thermal expansion of the borides FeB and Fe_2B, obtained by the method of high-temperature radiography, the time and residual stresses in oriented boride coatings were calculated. (tr-auth)

25100 BINDING ENERGIES IN CUBIC METAL SURFACES. Jackson, D. P. (Chalk River Nuclear Lab., Ont.). Radiat. Eff.; 18: No. 3-4, 185-189(1973).

Surface binding energies are calculated using Morse potentials for the (100), (110), and (111) surfaces of seven fcc and nine bcc metals. Estimates are made for a further seven metals. Surface relaxation effects are included and their effect discussed. The surface binding energies are found to be greater than the sublimation energy per atom of the solid. Qualitative arguments are proposed to explain the ordering of binding energies between crystal faces. Comparison with experimental data for the adsorption energies of tungsten atoms on tungsten crystal faces indicates the plausibility of the calculated values. (auth)

25101 SECONDARY ION EMISSION OF ALLOYS IN RELATION WITH THEIR ELECTRONIC STRUCTURE. Blaise, G. (Paris Univ., Orsay, France). Radiat. Eff.; 18: No. 3-4, 235-240(1973).

When an atom crosses a metal/vacuum surface, the perturbation acting upon outer electronic shells produces excited states the energy of which exceeds, in some cases, the ionization energy of the atom. A secondary positive ion emission process from metals and alloys is proposed, based upon the formation of auto-ionizing states. In such a process, the ion yield K^+ of an element is proportional to the occupation probability of auto-ionizing states. The probability is closely connected to the density of states around the element inside the metal or alloy, in a small bandwidth energy near the Fermi level; the greater the fraction of valence electrons of the atom in this bandwidth, the higher the occupation probability will be. This relation explains the enhancement observed experimentally in the ion emission of transition elements (from Ti to Cu) in dilute alloys. This effect is particularly noticeable when d electrons of transition elements are distributed in a virtual bound state which crosses the Fermi level as in the case of chromium in nickel matrix or transition elements in aluminium or copper matrix. (auth)

25102 CALCULATION OF THE MAGNETIZATION AND TOTAL ENERGY OF VANADIUM AS A FUNCTION OF LATTICE PARAMETER. Hattox, T. M.; Conklin, J. B. Jr.; Slater, J. C.; Trickey, S. B. (Univ. of Florida, Gainesville). J. Phys. Chem. Solids; 34: No. 10, 1627-1638(Oct 1973).

Self-consistent spin-polarized APW (Augmented Plane Wave) calculations were performed to determine the energy band structure of metallic vanadium in an assumed ferromagnetic bcc structure as a function of lattice parameter. The statistical exchange ("Xα") and muffin-tin approximations were used. At each lattice parameter for which a calculation was performed, the Xα cohesive energy, the pressure, and the magnetization were calculated. The calculated cohesive energy and pressure agree fairly well with experiment. The calculations also correctly predict the absence of a magnetic moment for vanadium at its equilibrium lattice constant, However, a nonmagnetic-to-magnetic transition is found to occur abruptly at a lattice constant which is about a factor of 1.25 larger than the equilibrium value, and which is in good qualitative agreement with the appearance of a local magnetic moment in certain vanadium alloys. (auth)

25103 TUNGSTEN AS A STANDARD MATERIAL FOR MONOCHROMATIC EMISSIVITY. Latyev, L. N.; Chekhovskoi, V. Y.; Shestakov, E. N. (Inst. of High Temperature, Moscow). High Temp.-High Pressures; 4: No. 6, 679-686(1972).

From 3rd European conference on the thermophysical properties; Turin, Italy (20 Jun 1972).

On the basis of a critical analysis of the available experimental data, the most reliable values of normal monochromatic emissivity of tungsten are tabulated for the wavelength range 0.3 to 5.0 μm and temperature range 1200 to 2600°K. The recommended values relate to polycrystalline tungsten having an intergranular boundary area of ~10%. (auth)

25104 STRAIN ENERGY EFFECTS AND MELTING OF MISCIBLE ALLOYS. Ferro, A.; Lo Vecchio, G.; Mezzetti, F. (Univ., Ferrara, Italy). High Temp.-High Pressures; 4: No. 6, 703-706 (1972).

From 3rd European conference on thermophysical properties; Turin, Italy (20 Jun 1972).

The problem of the melting of binary alloys with complete miscibility is considered. Among these Mo-Ti, Nb-Ti, Nb-U, Nb-Zr, Ta-Ti, Th-Zr, Ti-U, Ti-V, and U-Zr are of interest in nuclear technology. On the hypothesis that the lowering of the melting point of intermediate alloys with respect to the weighted average for the two metals is essentially due to a strain energy effect, it is shown that the ratio $4\Delta T_m/T_c$ (where ΔT_m is the maximum lowering of the melting point and T_c is the critical temperature of the ordered phase when present) should be equal to 1, since the ordering energy is referred to the same origin. Good agreement with experimental data is found in many cases, particularly for Cu-Au, which is the alloy most representative of the effect. Furthermore, the absolute values of the strain energy of the solid solution evaluated on the basis of the standard theory of elasticity are of the correct order of magnitude when compared with values calculated from experimental data. The reasons for certain discrepancies are shown to be at least qualitatively understood. (auth)

25105 INVESTIGATION OF THE ELECTRICAL RESISTANCE AND EMISSIVITY OF METALS AT HIGH TEMPERATURES. Kraev, O. A.; Evgen'ev, N. A. Heat Transfer-Sov. Res.; 5: No. 3, 167-171(1973).

Development and evaluation of methods and equipment for measurement of electric conductivity and emissivity in metals simultaneously are described. Data obtained using the equipment are presented on the electric conductivity and emissivity of Mo and W at 1100 to 1700°K. (JRD)

25106 NEUTRON-DIFFRACTION STUDY OF SINGLE-CRYSTAL EUROPIUM IN AN APPLIED MAGNETIC FIELD. Millhouse, A. H. (Danish Atomic Energy Commission, Risoe); McEwen, K. A. Solid State Commun.; 13: No. 3, 339-345(1 Aug 1973).

A single crystal of europium was studied in applied magnetic fields up to 41.7 kOe. At $T_N = 90.5 \pm 0.5$°K, a first-order magnetic transition is observed. At 4.2°K, the effect of an applied magnetic field in either a ⟨100⟩ or ⟨110⟩ direction is to stabilize a helix structure having τ along the field direction. This field-stabilized structure remains even if the field is reduced to zero. The hysteresis associated with these transformations was investigated and is discussed. No ferromagnetic components were detected in fields up to 41.7 kOe. (auth)

25107 INVESTIGATION OF THE THERMAL EXPANSION OF MOLYBDENUM AND TUNGSTEN AT HIGH TEMPERATURES. Petukhov, V. A.; Chekhovskoi, V. Y. (Inst. of High Temperature, Moscow). High Temp.-High Pressures; 4: No. 6, 671-677(1972).

From 3rd European conference on thermophysical properties; Turin, Italy (20 Jan 1972).

A procedure and apparatus for studying the thermal expansion of refractory metals up to temperatures near their melting points is described. Results are presented for molybdenum in the range 1800 to 2546°C and tungsten in the range 1950 to 3335°C. The overall error in the thermal expansion coefficient is 0.7 to 0.9% with a confidence interval of 0.95. (auth)

25108 EXPERIMENTAL INVESTIGATION OF THE INTEGRAL HEMISPHERICAL EMISSIVITY OF REFRACTORY METALS AND ALLOYS. Peletskii, V. E.; Druzhinin, V. P. Heat Transfer-Sov. Res.; 5: No. 3, 172-175(1973).

Results of integral hemispherical emissivity measurements on Mo, Mo-Re alloys, and Re at 1200 to 2600°K are presented. The data are presented in curves and tables and compared with data in the literature. (JRD)

25109 CORRELATION OF SOME THERMODYNAMIC PROPERTIES OF THE LANTHANIDE AND ACTINIDE METALS. Nugent, L. J.; Burnett, J. L.; Morss, L. R. (Oak Ridge National Lab., TN). J. Chem. Thermodyn.; 5: No. 5, 665-678(Sep 1973).

Some of the thermodynamic and spectroscopic properties of the metals M of the lanthanide and actinide series are correlated. The enthalpy of sublimation at 298.15°K, $\Delta H_f^0(M)$, the standard enthalpy of formation of the metal aquo ion at 298.15°K, $\Delta H_f^0\{M(III), aq\}$, and the difference in energy $\Delta E(M)$ between the lowest lying energy level of the trivalent $f^n s^2 d^1$ electronic configuration and the lowest lying energy level of the divalent $f^{n+1} s^2$ configuration of the neutral gaseous atoms are treated. Previously reported results most likely to be found in error are pointed out, and best values of $\Delta H_f^0(M)$ and $\Delta H_f^0\{M(III), aq\}$ for each member of the lanthanide and actinide series are presented. The trends observed in $\Delta H_f^0(M)$ and $\Delta H_f^0\{M(III), aq\}$ across each series are discussed in relation to the number of valence electrons per atom in the crystalline metals and in the gaseous metal atoms. (auth)

25110 PHONON DISPERSION RELATIONS FOR BERYLLIUM AND MAGNESIUM. Rajput, J. S. (Regional Coll. of Education Bhubaneswar, India); Kushwaha, S. S. J. Phys., F (London); 3: No. 8, 1531-1537(Aug 1973).

Calculations are presented of phonon dispersion relations and lattice specific heats for the case of beryllium and magnesium using Krebs' model, originally developed for bcc structure and extended to hcp structure. The computed vibration frequencies and lattice specific heats are in reasonably good agreement with the available experimental results. (auth)

25111 LATTICE DISTORTION DUE TO GAS INTERSTITIALS IN BCC METALS. Tewary, V. K. (Atomic Energy Research Establishment, Harwell, Eng.). J. Phys., F (London); 3: No. 8, 1515-1523(Aug 1973).

The static lattice distortion and relaxation energy for nitrogen and oxygen interstitials at octahedral and tetrahedral sites in niobium, tantalum and vanadium were calculated using the Green function method for lattice statics. The forces responsible for the lattice distortion were obtained from the measured values of the dipole tensor, which avoids the need for a priori knowledge of the gas-host potential. However, simple functions for the "effective" gas-host interaction were fitted to the calculated values of the atomic displacements which should be useful for further calculations on these systems. (auth)

25112 SOME PHYSICAL PROPERTIES OF HOT-EXTRUDED TUNGSTEN-COPPER PSEUDOALLOYS. Karpinos, D. M.; Kondrat'ev, Yu. V.; Klimenko, V. S.; Barantseva, I. G.; Pilipovskii, Yu. L.; Dobroval'skii, O. A.; Shamatov, Yu. M. Heat Transfer-Sov. Res.; 5: No. 3, 155-158(1973).

Results of research on properties of W-8 to 9% Cu alloys at 20 to 2000°C are presented. Data are presented and discussed on thermal conductivity of the alloys at 100 to 2000°C, electric conductivity at 20 to 1700°C, and thermal expansion at 20 to 2000°C. (JRD)

25113 REDISTRIBUTION OF ELEMENTS IN BORIDE COATINGS. Dukarevich, I. S.; Mozharov, M. V.; Shigarev, A. S. Metal Sci. Heat Treat. (USSR) (Engl. Transl.); 15: No. 1-2, 160-162(1973).

Translated from Metalloved. Term. Obrab. Metal.; 15: No. 2, 64-66(Feb 1973).

The distribution of C and alloying elements between phases and zones in boride coatings on steel was investigated. It was found that surface saturation of steel with boron in the process of electrolytic boriding is accompanied by diffusion redistribution of carbon and alloying elements. The direction and intensity of the transfer of carbon and alloying elements depend on their affinity for boron and the phases formed. The redistribution of carbon causes decarburizing of the zone of borides, and also the zone of α phase in silicon steels, and saturation of the transition zone. The highest carbon concentration in the transition zone exceeds the average concentration in the alloy by 20 to 100%; the character of the dis-

tribution depends on the structure of the boride case. Silicon diffuses into the core during boriding, enriching the zone of α phase, and promoting the formation of three zones in the layer (borides, α phase, and transition zone) that differ sharply in composition and have substantial effects on the properties of the boride case. Chromium and manganese diffuse to the surface during boriding, enriching the zone of borides, but with no substantial effect on the structure of the boride case. (JRD)

25114 STRUCTURE AND PROPERTIES OF WEAR-RESISTANT NICKEL-BASE ALLOYS. Nikandrova, E. A.; Maslenkov, S. B. (Central Scientific-Research Inst. of Ferrous Metallurgy, Moscow). Metal Sci. Heat Treat. (USSR) (Engl. Transl.); 15: No. 1-2, 139-142 (1973).

Translated from Metalloved. Term. Obrab. Metal.; 15: No. 2, 47-51 (Feb 1973).

The effects of heat treatments on the structure and properties of Ni-base–Mo–W alloys were studied. It was found that alloying nickel with a large amount of molybdenum and tungsten makes it possible to produce nonmagnetic alloys for special purposes with a hardness and strength similar to those of tool steels. As-quenched, Ni alloy N65M20V15 consists of γ solid solution with a fcc lattice, and Ni alloy N55M20V25 of $\alpha + \gamma$ solid solution. The α phase has a bcc lattice. Both alloys contain M_6C carbides. The high hardness of these alloys after aging is due to precipitation of tetragonal $Ni_4(Mo, W)$ phase and M_6C carbide. The alloys retain a high hardness up to 600°C in short-term and long-term tests (1000 h) due to the presence of $Ni_4(Mo, W)$. The presence of α phase based on molybdenum in Ni alloy N55M20V25, unlike Ni alloy N65M20V15, is responsible for the resistance to tempering up to 900°C; it does not cause any sharp changes in the strength, ductility, or toughness in relation to the tempering temperature; it is responsible for the higher ductility of Ni alloy N55M20V25 at high temperatures as compared with Ni alloy N65M20V15. The best combination of hardness, strength, and ductility is attained for Ni alloy N55M20V25 in the overaged condition. (JRD)

25115 TEMPERATURE DEPENDENCE OF HARDNESS AND CREEP OF ALLOY Rh–^{18}Re. Tsvetaev, A. A.; Balakhovskii, O. A.; Chuzhko, R. K.; Grishina, S. P. (Inst. of Physical Chemistry, Moscow). Metal Sci. Heat Treat. (USSR) (Engl. Transl.); 15: No. 1-2, 40-42 (1973).

Translated from Metalloved. Term. Obrab. Metal.; 15: No. 1, 39-42 (Jan 1973).

The investigation was conducted at about 400 to 1300°C. Results show that by comparison of the strength characteristics of the Rh–Re alloy with pyrolytic tungsten in vacuum at elevated temperatures it can be seen that the alloy of rhodium with 18% Re is less susceptible to softening and more highly resistant to creep at relatively high stresses and temperatures around 1000°C. (JRD)

25116 ALLOYING AND THE HEAT RESISTANCE OF ALLOYS. Nazarov, E. G. (Central Scientific-Research Inst. of Ferrous Metallurgy, Moscow). Metal Sci. Heat Treat. (USSR) (Engl. Transl.); 15: No. 1-2, 53-56 (1973).

Translated from Metalloved. Term. Obrab. Metal.; 15: No. 1, 54-54 (Jan 1973).

Data on effects of chemical composition on heat resistance of Ni-base alloys used in the USA and USSR are reviewed. Alloying elements discussed include Ti, Al, W, Mo, Nb, Ta, Co, Cr, Hf, Re, and Y. (JRD)

25117 TECHNOLOGICAL AND CUTTING PROPERTIES OF HIGH-VANADIUM HIGH-SPEED STEELS. Zaitsev, I. F.; Rogovtsev, V. P.; Doronin, V. M. Metal Sci. Heat Treat. (USSR) (Engl. Transl.); 15: No. 1-2, 95-97 (1973).

Translated from Metalloved. Term. Obrab. Metal.; 15: No. 2, 7-9 (Feb 1973).

The investigation was conducted using annealed quenched vanadium steels. It was found that economically alloyed high-speed steels with a high vanadium content (8%) and low tungsten content (2.5%) are superior to R18 steel in heat resistance and in cutting properties. The wear resistance of blades of high-vanadium steels in gear cutting at rates over 60 rev/min and feeds of 0.25 to 0.75 mm/rev is higher than that of R18 steel. High-speed steels with a high vanadium content (8%) and low tungsten content (2.0 to 2.5%) can be quenched to a grain size of grade 11. An increase of the chromium content from 4% to 6% in high-V steel is inadvisable, since it does not improve the durability of cutting tools. High-vanadium steels can be recommended for tools with minimal grinding or no grinding. (JRD)

25118 EFFECT OF ERBIUM ON MAGNETIZATION OF Ho–Dy ALLOYS. Elyutin, O. P.; Pshechenkova, G. V.; Taratynov, V. P.; Shul'te, L. A. (Central Scientific-Research Inst. of Ferrous Metallurgy, Moscow). Metal Sci. Heat Treat. (USSR) (Engl. Transl.); 15: No. 1-2, 113-114 (1973).

Translated from Metalloved. Term. Obrab. Metal.; 15: No. 2, 24-25 (Feb 1973).

The magnetization of polycrystalline Ho, Dy, Er, binary Ho–Dy alloy, and ternary Er–Ho–Dy alloy were studied. Results are presented in magnetization curves. Recommendations for fabrication of cores for operation in magnetic yields are given. (JRD)

25119 PROPERTIES AND STRUCTURE OF SUPERCONDUCTING Ti–Nb ALLOYS. Kadykova, G. N. (Moscow Inst. of Electronic Machine Construction). Metal Sci. Heat Treat. (USSR) (Engl. Transl.); 15: No. 1-2, 118-122 (1973).

Translated from Metalloved. Term. Obrab. Metal.; 15: No. 2, 28-32 (Feb 1973).

Work connecting the critical current density with the character and size of precipitates, still offers no basis for agreement on the best structure of superconductors based on Ti–Nb. Various authors indicate that the best properties are obtained with precipitates of the Guinier–Preston zone type, intermediate phases, ω or α phase, and the size of the precipitates in all cases is several hundred angstroms. Evidently it is important to obtain a high density of precipitates of that size as well as even distribution. In studying the structure of superconducting alloys the density and distribution of dislocations must also be considered. The conditions of quenching, deformation, and aging to obtain the best structure must be selected in relation to the chemical composition of the alloy and the preliminary treatment, including intermediate heat treatment in the process of cold deformation. (auth)

25120 DECOMPOSITION OF MARTENSITE DURING TEMPERING OF RHENIUM STEELS. Lysak, L. I.; Andrushchik, L. O. (Inst. of Metallography, Kiev). Metal Sci. Heat Treat. (USSR) (Engl. Transl.); 15: No. 1-2, 5-8 (1973).

Translated from Metalloved. Term. Obrab. Metal.; 15: No. 1, 3-7 (Jan 1973).

The ordering process of C atoms in martensite lattice was investigated by studying the mechanism of martensitic transformation in steels alloyed with Re. It was found that the first state of martensite decomposition is two-phase in rhenium steels with 0.3 to 1.4% C and 10 to 20% Re, and three-phase in steels with 1.6 to 1.7% C and 3 to 6% Re. Increasing the carbon and rhenium concentrations of the steel lowers the rate of the first stage of decomposition. With increasing concentrations of carbon in the steel the tetragonality of the α martensite lattice increases, as a result of the larger elastic deformation of the lattice resulting from coherence with the lattice of precipitates rich in carbon. (JRD)

25121 MAGNETIC SUSCEPTIBILITY OF THE Sn–Cd SYSTEM ALLOYS. Kuz'menko, P. R.; Kal'naya, G. I.; Suprunenko, P. A. Ukr. Fiz. Zh. (Russ. Ed.); 18: No. 5, 797-802 (May 1973). (In Russian).

Results of studies in temperature and concentrational dependences of magnetic susceptibility in the Sn–Cd system alloys are presented. On the basis of the results, a conclusion is made on unlimited mutual solubility of the components at a liquid state and the values are determined characterizing the state of conduction electrons in melts (the melt electronic structure). (auth)

25122 HYPERFINE FIELDS IN THE ITINERANT FERROMAGNET $ZrZn_2$. Murdoch, B. T.; Olsen, C. E.; Steyert, W. A. (Los Alamos Scientific Lab., NM). Phys. Lett.; 44A: No. 6, 413-414 (16 Jul 1973).

Upper limits of 25, 60, and 30 kOe, respectively, are placed on the magnitudes of hyperfine fields at the sites of Zn, Zr, and Nb in activated $ZrZn_2$, determined from γ-ray asymmetries with cryogenically aligned isotopes. The extent of s–d hybridization of conduction electrons is thus small. (auth)

25123 YIELD STRESS OF $Ni_3(Al, W)$. Mulford, R. A.; Pope, D. P. (Univ. of Pennsylvania, Philadelphia). Acta Met.; 21: No. 10, 1375-1380 (Oct 1973).

An investigation of the mechanical behavior in compression of oriented $Ni_3(Al, W)$ single crystals was undertaken. The yield stress at a plastic strain of 5×10^{-5} was obtained over the temperature range 77 to 875°K for samples prestrained at 77°K. Dislocation rearrangements in specimens prestrained at 77°K and then stressed at 298°K demonstrate that the 5×10^{-5} offset yield stress is controlled by the easy movement of edge dislocations. This results in an exhaustion hardening phenomenon in the premacroyield region due to the loss of mobile edge dislocations. A measurement of the macroscopic yield stress reveals a temperature dependence between 77 and 4°K typical for pure fcc metals. (auth)

25124 THERMODYNAMICS OF TRANSITION METAL–HYDROGEN SOLID SOLUTIONS. Arnoult, W. J.; McLellan, R. B. (Rice Univ., Houston, TX). Acta Met.; 21: No. 10, 1397-1403 (Oct 1973).

The temperature variation of the solubility of hydrogen in chromium and tungsten in equilibrium with H_2 gas was measured. The measured solubility data yield accurate values of the partial molar enthalpy and excess entropy of a dissolved hydrogen atom. The thermodynamic functions found for Cr–H and W–H solid solutions were compared with those for other transition-metal solid solutions containing hydrogen. The relation between the partial enthalpy of solution and the screened proton model of H-metal solid solutions is discussed. (auth)

25125 ELASTIC PROPERTIES OF DySb NEAR THE MAGNETIC AND STRUCTURAL PHASE TRANSITION. Moran, T. J.; Thomas, R. L. (Physics Department, Wayne State University, Detroit, Michigan 48202); Levy, P. M.; Chen, H. H. Phys. Rev. B 7: No. 7, 3238-3241 (1 Apr 1973).

The shear elastic constants c_θ and c_{44}, have been measured in DySb. C_{44} shows a small softening of about 0.6% at the phase transition, while c_θ exhibits a 58% drop. The large change in c_θ occurs over a temperature range of more than 200 °K. The dominant mechanism for the softening of the elastic constant c_θ is a Jahn–Teller strain coupling. Strong–biquadratic pair interactions are present which compete with the strain coupling. (auth)

25126 RESISTIVITY STUDIES OF ANTIFERROMAGNETIC Mn-RICH ALLOYS CONTAINING UP TO 2.5–AT. % V, Cr, Fe, AND Ru. Williams, W. Jr.; Stanford, J. L. (Ames Laboratory–USAEC and Department of Physics, Iowa State University, Ames, Iowa 50010). Phys. Rev. B; 7: No. 7, 3244-3250(1 Apr 1973).

In an attempt to better understand the nature of the complex magnetic interaction in antiferromagnetic α–Mn, we have undertaken an experimental determination of the Néel temperatures (T_N) of manganese–rich Mn–V, Mn–Cr, Mn–Fe, and Mn–Ru alloys. The electrical resistivities of Mn samples containing up to approximately 2.5 at.% of V, Cr, Fe, and Ru have been studied from 4.2 K to room temperature. Anomalies in the temperature dependence of the alloy resistivities at the onset of antiferromagnetic ordering reveal that dissolving V or Cr into Mn depresses T_N, while dissolving Fe or Ru into Mn raises the Néel temperature of the alloy. The data reveal that the introduction of impurity atoms into α–Mn does not affect the antiferromagnetic coupling by a simple dilution process. T_N exhibits a striking dependence on both the magnitude and sign of the excess electron concentration in the alloys. (auth)

25127 SOFT-X-RAY ABSORPTION THRESHOLD IN METALS, SEMICONDUCTORS, AND ALLOYS. Flynn, C. P. (Physics Department, Materials Research Laboratory, University of Illinois, Urbana Illinois 61801); Lipari, N. O. Phys. Rev. B 7: No. 6, 2215-2229 (15 Mar 1973).

We report calculations of the K edges in Li and Be and the L_{23} edges in Na, Mg, Al, and Si. The calculations use self-consistent core and valence-electron densities for both the ground and excited configurations; corrections for the host ionic fields are incorporated, using pseudopotential methods. It is found that the calculated edge energies are in close agreement with experiment when Schneider's values of the bulk chemical potential are used for the excited electron. In further studies of inhomogeneous systems, we show that the core threshold is highly insensitive to atomic environment, so that amorphous materials can be discussed. The case of dilute alloys is treated and core recombination in AlMg alloys is analyzed in detail. The effects studied here indicate that the surface barriers caused by the dipole moments of surface atoms are small, most probably $\lesssim 0.1$ Ry, in all the materials treated here. (auth)

25128 EXCHANGE CORRECTIONS TO THE CRYSTALLINE FIELD PARAMETER C_4 FOR RARE EARTHS IN THE NOBLE METALS. Chow, H. C. (Department of Physics, University of California, Los Angeles, California 90024). Phys. Rev. B 7: No. 7, 3404-3405 (1 Apr 1973).

A suggestion of Coles and Orbach involving the formation of virtual bound states is shown to account for the fourth-order crystalline field parameter in simple rare-earth-doped metals. (auth)

25129 THERMAL CONDUCTIVITY AND LORENZ NUMBER OF TUNGSTEN–RHENIUM ALLOYS IN THE SOLID-SOLUTION REGION (0–27% Re) AT TEMPERATURES OF 1200–3000°K. Vertogradskii, V. A.; Chekhovskoi, V. Y. (Institute of High Temperatures, Academy of Sciences of the USSR). High Temp. 10: No. 5, 893-896 (May 1973).

Information is given on the thermal conductivity of four alloys measured with a precision of 3–5%. It is found that the Lorenz number of the alloys depends linearly on the product of the atomic concentrations of the components. (auth)

25130 ENERGY DISTRIBUTIONS OF FIELD-EMITTED ELECTRONS FROM TUNGSTEN IN THE PRESENCE OF ADSORBED CO. Young, P. L.; Gomer, R. (The James Franck Institute and The Department of Chemistry, The University of Chicago, Chicago, Illinois, 60637). Phys. Rev. Lett. 30: No. 20, 955-958 (14 May 1973).

Measurements of the energy distribution in the presence of adsorbed CO are given for the (110), (210), and (100) planes of W. The results are discussed in terms of binding models. (auth)

25131 INTERPOLATION EQUATION OF STATE OF TUNGSTEN. Fortov, V. E.; Lomakin, B. N. (Branch of Institute of Chemical Physics, Academy of Sciences of the USSR). High Temp. 10: No. 5, 1003-1004 (May 1973).

The lower limit of applicability of quantum-statistical models of the equation of state is at a pressure on the order of 100 Mbars. Shock adiabats of many substances have been measured at pressures up to 10 Mbars. To determine the equation of state in the intervening region interpolation is necessary. Such an equation is constructed for W, and the coefficients are tabulated. Hugoniot adiabats for different initial porosities are shown. (1 figure, 1 table) (RWR)

25132 THERMAL PROPERTIES OF RHENIUM SINGLE CRYSTALS AT HIGH TEMPERATURES. Logunov, A. V. (Moscow). High Temp. 10: No. 5, 889-892 (May 1973).

The results are given of the measurements of the thermal conductivity, the electrical resistivity, and the total hemispherical and spectral ($\lambda = 0.65$ μ) emissivity of rhenium single crystals at 1000–2800°C. It is shown that the conductivity of rhenium single crystals depends strongly on the orientation. (auth)

25133 DETERMINATION OF COMPOUND NUCLEAR LIFETIMES BY THE BLOCKING TECHNIQUE. Hashimoto, Y. (Rutgers University, New Brunswick, New Jersey, 08983); Barrett, J. H.; Gibson, W. M. Phys. Rev. Lett. 30: No. 20, 995-998 (14 May 1973).

We report the results of a comprehensive computer simulation of angular distributions of 4.0-MeV protons scattered by a 3-μm-thick Ge crystal and emerging near a <110> direction. They show that interpretation of measured blocking distributions to obtain short nuclear lifetimes is strongly dependent on the recoil direction and depth distribution of the recoiling compound nuclei in the crystal. This dependence is explained in terms of the associated flux peaking effect in particle channeling. (auth)

25134 PHOTO-EMISSION MEASUREMENTS OF LIQUID In AND Sn. Norris, C.; Rodway, D. C.; Williams, G. P. (Univ. of Leicester, Eng.). pp 181-187 of Properties of Liquid Metals. Takeuchi, S. (ed.). New York; John Wiley and Sons, Inc. (1973).

From 2nd international conference on the properties of liquid metals; Tokyo, Japan (3 Sep 1972). See CONF-720996-.

Photo-emission measurements have been made on liquid indium and tin under ultra-high vacuum conditions with photon energies up to 21.2 eV. The energy distribution curves are sharp and for indium reveal more structure than previously reported. No evidence of direct k-conserving transitions is observed and the results are interpreted in terms of the occupied density of states. (auth)

25135 KNIGHT SHIFTS IN METALS AND ALLOYS. Ford, C. J.; Styles, G. A. (Univ. of Warwick, Coventry, Eng.). pp 189-196 of Properties of Liquid Metals. Takeuchi, S. (ed.). New York; John Wiley and Sons, Inc. (1973).

From 2nd international conference on the properties of liquid metals; Tokyo, Japan (3 Sep 1972). See CONF-720996-.

Measurements are presented, of the Knight shifts $K(^{119}Sn)$ and $K(^{113}Cd)$ in liquid Sn and Cd and liquid Sn–Cd alloys, and of the magnetic susceptibility in these systems and in liquid Ga, In, Pb and Bi. The Knight shift results, together with existing measurements of the shifts in Ga, In, Pb and Bi, are interpreted in terms of the Fermi contact interaction. Values of the contact density at the nucleus for the conduction electrons are calculated by explicitly orthogonalizing the conduction-electron pseudo-wavefunctions to the core states while the spin susceptibilities are extracted from the measured susceptibilities by subtracting estimates of the diamagnetic contributions from the ion cores and conduction electrons. Although the predicted values for the absolute magnitudes of the shifts are too small, reasonable agreement between theory and experiment is obtained both for the temperature dependences in the pure metals and for the variations with composition in the Sn–Cd alloys. (auth)

25136 ELECTRONIC STRUCTURE OF LIQUID TRANSITION AND RARE EARTH METALS AND THEIR ALLOYS. Busch, G.; Guentherodt, H. J.; Kuenzi, H. U.; Meier, H. A. (Eidgenoessische Technische Hochschule, Zurich). pp 263-276 of Properties of Liquid Metals. Takeuchi, S. (ed.). New York; John Wiley and Sons, Inc. (1973).

From 2nd international conference on the properties of liquid metals; Tokyo, Japan (3 Sep 1972). See CONF-720996-.

The measurements of the Hall coefficient, the electrical re-

sistivity, and the magnetic susceptibility of liquid transition and light rare-earth metals and their alloys are reviewed. The results are compared with recent theories, taking into account the 3d and 4f states, respectively. (10 figures, 19 references) (auth)

25137 MUTUAL DIFFUSION IN INDIUM–LEAD LIQUID ALLOYS. Rialland, J. F.; Robert, J. (Laboratoire de Genie Electrique de Paris, Fontenay-aux-Roses, France). pp 549-553 of Properties of Liquid Metals. Takeuchi, S. (ed.). New York; John Wiley and Sons, Inc. (1973).

From 2nd international conference on the properties of liquid metals; Tokyo, Japan (3 Sep 1972). See CONF-720996-.

Mutual diffusion was studied in the indium–lead liquid system. The D coefficients were determined from diffusion profiles by using the Boltzmann–Matano analysis. It was established that D depends on concentration and is minimum for 70 at.% Pb. For temperatures higher than the Pb melting point, D can be described by the Arrhenius relation. The activation energy is close to 3.9 kcal/mol in the range 30 to 70% at. Pb. (auth)

25138 VISCOSITY OF LIQUID RARE-EARTH AND ACTINIDE METALS. Wittenberg, L. J.; DeWitt, R. (Monsanto Research Corp., Miamisburg, OH). pp 555-560 of Properties of Liquid Metals. Takeuchi, S. (ed.). New York; John Wiley and Sons, Inc. (1973).

From 2nd international conference on the properties of liquid metals; Tokyo, Japan (3 Sep 1972). See CONF-720996-.

The viscosities of the rare-earth metals, La, Ce, Pr, and Yb, and the actinide elements, U and Pu, which have been measured at this laboratory, are compared using several suggested correlations. A hard-sphere description of viscous flow was derived, and a corresponding-states correlation based upon an energy parameter of the interatomic energy function was applied to these metals. For both of these correlations, the calculated viscosities at the melting temperatures were too low for Ce, U, and Pu. Apparently the viscous properties of these abnormal metals are affected by the f-orbital electronic contributions to their melting behavior. (auth)

25139 MAGNETIC SPECIFIC HEAT ANOMALY IN $GdNi_2$. Cannon, J. A. (Fordham Univ., Bronx, NY); Budnick, J. I.; Craig, R. S.; Sankar, S. G.; Keller, D. A. AIP (Amer. Inst. Phys.) Conf. Proc.; No. 10, 905-909(1973).

From 18th annual conference on magnetism and magnetic materials; Denver, Colorado, USA (28 Nov 1972). See CONF-721114-P2.

The critical behavior of the magnetic contribution to the heat capacity in $GdNi_2$ was accurately determined, using both a phase-sensitive ac technique in the critical region and a calorimetric technique from helium temperature up to room temperature. The deduced values of critical exponents are $\alpha = 0.36$ and $\alpha' = 0.026$. (auth)

25140 MAGNETIC PROPERTIES OF SOME RARE EARTH–GOLD COMPOUNDS. Sill, L. R. (Northern Illinois Univ., DeKalb); Snow, S. R.; Fedro, A. J. AIP (Amer. Inst. Phys.) Conf. Proc.; No. 10, 1060-1064(1973).

From 18th annual conference on magnetism and magnetic materials; Denver, Colorado, USA (28 Nov 1972). See CONF-721114-P2.

A magnetic susceptibility study of the b.c. tetragonal $MoSi_2$-type intermetallic compounds RAu_2, where R is one of the heavy rare earths (Gd, Tb, Dy, Ho, Er, Tm), was made at temperatures from 2.5 to 300°K in applied fields up to 26 kOe. The temperature dependence of the inverse susceptibility at high temperatures for these compounds followed the Curie–Weiss law giving effective moments close to those of the trivalent rare-earth ions. At low temperatures, antiferromagnetic behavior was observed in all of these compounds. In addition, a first-order magnetic transition was observed below their Neel temperatures for $TbAu_2$ and $DyAu_2$. These observations are in agreement with the neutron diffraction results of Atoji. The results are interpreted by using the RKKY interaction along with an anisotropic field term. (5 figures, 16 references) (auth)

25141 MAGNETIC PROPERTIES OF $Y_{1-x}Th_xFe_3$ AND $Lu_{1-x}Th_xFe_3$. Kunesh, C. J.; Narasimhan, K. S. V. L.; Butera, R. A. (Univ. of Pittsburgh). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 10, 1065-1069(1973).

From 18th annual conference on magnetism and magnetic materials; Denver, Colorado, USA (28 Nov 1972). See CONF-721114-P2.

The pseudobinary compounds studied all exhibit the $PuNi_3$-type structure. For $x \leq 0.3$, the magnetization vs temperature behavior for both systems is consistent with a simple ferromagnetic iron sublattice. For $x > 0.3$ (excluding $x = 1$), these systems show anomalies in M vs T and M vs H data. These anomalies arise from a noncollinear to collinear spin structure transition within the iron sublattice. Results are explained on the basis of a hybrid local moment-band model originally proposed by Friedel. (auth)

25142 STABILIZATION OF THE 5f ENERGY BAND IN ACTINIDE–Rh_3 INTERMETALLIC COMPOUNDS. Nellis, W. J. (Argonne National Lab., IL); Harvey, A. R.; Brodsky, M. B. AIP (Amer. Inst. Phys.) Conf. Proc.; No. 10, 1076-1080(1973).

From 18th annual conference on magnetism and magnetic materials; Denver, Colorado, USA (28 Nov 1972). See CONF-721114-P2.

Magnetic susceptibilities and electrical resistivities of $ThRh_3$, URh_3, $NpRh_3$, and $PuRh_3$ were measured from 2 to 300°K. These compounds have the cubic $AuCu_3$-type structure with a total lattice parameter variation of only 0.5% for the latter three compounds. These materials are metallic and have room-temperature resistivities of about 50 $\mu\Omega$-cm. The susceptibility of $ThRh_3$ is temperature-independent. The URh_3 susceptibility decreases weakly with temperature. The susceptibility of $NpRh_3$ has a large 0°K-value of 5.5×10^{-6} emu/g, decreases as $-T^2$ up to 125°K, and then fits a Curie–Weiss law with $p_{eff} = 3.63\ \mu_B/NpRh_3$ and $\theta = -483$°K. $PuRh_3$ is antiferromagnetic below $T_N = 6.6$°K. The resistivities of $ThRh_3$, URh_3, and $NpRh_3$ increase from their residual values as $\rho = \rho_0 + AT^n$, where n = 5, 3, and 2, respectively. The $PuRh_3$ resistivity follows $\rho = \rho_0 + AT$ above T_N. The data are interpreted by a model in which the 5f level is above the Fermi energy in $ThRh_3$, a broad, hybridized 6d-5f band overlaps the Fermi level in URh_3, $NpRh_3$ is nearly magnetic with a spin fluctuation temperature $T_S \simeq 15$°K, and $PuRh_3$ is weakly magnetic with a moment of about 1 μ_B subject to spin fluctuations above T_N. (auth)

25143 LOW-TEMPERATURE SPECIFIC HEAT AND MAGNETIC PROPERTIES OF RPt_5 (R = La, Ce, Pr, Nd) INTERMETALLIC COMPOUNDS. Narasimhan, K. S. V. L.; Rao, V. U. S.; Butera, R. A. (Univ. of Pittsburgh). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 10, 1081-1085(1973).

From 18th annual conference on magnetism and magnetic materials; Denver, Colorado, USA (28 Nov 1972). See CONF-721114-P2.

C_p of the RPt_5 intermetallic compounds having the hexagonal $CaCu_5$ structure was measured from 1.4 to 20°K. Magnetic susceptibility (χ) was also measured from 2 to 300°K. C_p of $LaPt_5$ followed $C_p = \gamma T + \beta T^3$ behavior. C_p of $CePt_5$ showed an upturn below 2.5°K while that of $NdPt_5$ exhibited a pronounced λ-type anomaly indicating the onset of magnetic order at 1.8°K. The entropy associated with the excess heat capacity was nearly Rln2, showing that only the lowest crystal field (CF) doublet of Nd^{3+} was populated at low T. C_p of $PrPt_5$ revealed a large Schottky anomaly, which can be associated with an overall splitting of about 380°K of the J = 4 ground multiplet of Pr^{3+}, with a predominant B_2^0 term. The χ of $PrPt_5$ calculated on the basis of this CF splitting was in reasonable agreement with the observed susceptibility behavior. The electrical resistivity of the compounds did not reveal any striking anomalies. (auth)

25144 MAGNETIC PROPERTIES OF RARE EARTH ATOMS IN PALLADIUM: CRYSTAL FIELD EFFECTS, EPR, AND MAGNETIC MOMENT. Praddaude, H. C. (Massachusetts Inst. of Tech., Cambridge); Guertin, R. P.; Foner, S.; McNiff, E. J. Jr. AIP (Amer. Inst. Phys.) Conf. Proc.; No. 10, 1115-1126(1973).

From 18th annual conference on magnetism and magnetic materials; Denver, Colorado, USA (28 Nov 1972). See CONF-721114-P2.

Recent studies of the magnetic properties of rare earth (RE) atoms dissolved in metals and particularly in Pd are reviewed. The effects of the crystalline electric field on the RE and the corresponding magnetic behavior and electron paramagnetic resonance (EPR) are discussed. Selected examples are chosen from an extensive series of magnetic measurements on dilute alloys of $Pd_{1-x}R_x$ where R = Ce, Pr, Nd, Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb, or Lu in order to illustrate the behavior of the RE in Pd. The magnetic properties of the RE in Pd are well described by a semi-empirical formula which yields the RE moment and hence the valence state, and host susceptibility. The temperature and field dependence of the magnetic moment also are compared with calculations based on crystal field parameters derived from a re-analysis of recent EPR measurements of RE ions in single-crystal Pd. This analysis shows that for Dy an effective spin Hamiltonian is not appropriate for describing the EPR data, but it is adequate for Er in Pd. (5 figures, 2 tables, 16 references) (auth)

25145 MECHANISMS OF MAGNETIC ANISOTROPY IN RARE EARTH METALS. Mackintosh, A. R. (AEK Research Establishment, Risoe, Denmark). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 10, 1256-1258(1973).

From 18th annual conference on magnetism and magnetic materials; Denver, Colorado, USA (28 Nov 1972). See CONF-721114-P2.

The way in which magnetic anisotropy in rare earth metals results from a combination of the crystal field and indirect exchange interactions is briefly discussed. The efficiency of neutron scattering for studying these interactions is emphasized. (auth)

25146 NMR IN $CeSn_xIn_{3-x}$ ALLOYS. Welsh, L. B. (Northwestern Univ., Evanston, IL); Darby, J. B. Jr. AIP (Amer. Inst. Phys.) Conf. Proc.; No. 10, 1325-1329(1973).

From 18th annual conference on magnetism and magnetic materials; Denver, Colorado, USA (28 Nov 1972). See CONF-721114-P2.

A study of the ^{119}Sn NMR Knight shifts and spin–lattice relaxation time was made in the $CeSn_xIn_{3-x}$ alloy system for $0.6 \leq x \leq 3.0$ to determine the variation of the magnetic behavior of the Ce f-electron with x. For $CeSn_3$, the Sn NMR properties are qualitatively similar to those of $LaSn_3$ which is consistent with the Ce f-electron occupying a virtual bound state. The NMR properties of the alloys are consistent with a sharp increase in the f-electron susceptibility with decreasing x down to $x = 1.8$ and suggest that a local moment picture for the Ce f-electron may be roughly correct for $0.6 \leq x \leq 1.8$. (auth)

25147 HALL AND MAGNETORESISTANCE EFFECTS IN Yb THROUGH THE fcc–hcp TRANSFORMATION. Hurd, C. M.; Alderson, J. E. A. (National Research Council of Canada, Ottawa). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 10, 1330-1334(1973).

From 18th annual conference on magnetism and magnetic materials; Denver, Colorado, USA (28 Nov 1972). See CONF-721114-P2.

The temperature dependence of the Hall and transverse magnetoresistance effects was measured in a polycrystalline sample of Yb (RRR = 17) showing the fcc–hcp transformation. The data cover the temperature range 1.8 to 420°K and field range up to 26 kOe, and they indicate that the behavior of the Hall effect through the transition arises primarily from the structural change and not from the associated magnetic transition. (auth)

25148 SUBLATTICE MAGNETIZATION AND THE EXCHANGE INTERACTION IN $Tb_zY_{1-z}Sb$. Cable, J. W. (Oak Ridge National Lab., TN); Comly, J. B.; Cooper, B. R.; Jacobs, I. S.; Koehler, W. C.; Vogt, O. AIP (Amer. Inst. Phys.) Conf. Proc.; No. 10, 1554-1558(1973).

From 18th annual conference on magnetism and magnetic materials; Denver, Colorado, USA (28 Nov 1972). See CONF-721114-P2.

Elastic neutron scattering was used to measure the sublattice magnetization of $Tb_zY_{1-z}Sb$ for $z = 1$, 0.91, 0.66, and 0.64. The moment/Tb at 0°K are 7.83, 7.57, 7.43, and 7.07 μ_B; and the T_N are 15.2, 13.4, 8.85, and 8.5°K, respectively. These T_N are quite close to those found in the same samples by susceptibility measurements, also used to fix the concentrations. The sublattice magnetizations and T_N are in good agreement with the behavior expected for an exchange field (H_{eff}) proportional to z and varying linearly with the moment/Tb (M). The linear exchange field coefficient (λ) is about 15% larger than that found in earlier bulk magnetic measurements in the paramagnetic regime, $z \leq 0.403$; and in contrast to the earlier work there is little, if any, need for contributions to H_{eff} with higher order dependence on M. (auth)

25149 COOPERATIVE JAHN–TELLER EFFECT IN DYSPROSIUM ANTIMONIDE. Uffer, L. F.; Levy, P. M.; Chen, H. H. (New York Univ., Bronx). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 10, 553-557(1973).

From 18th annual conference on magnetism and magnetic materials; Denver, Colorado, USA (28 Nov 1972). See CONF-721114-P1.

Recent magneto-thermal and elastic data on dysprosium antimonide were analyzed. Within the framework of the molecular-field approximation, the data was fit by using a model Hamiltonian which contains, besides the crystal-field term, bilinear and biquadratic pair interactions and a strain coupling of the lattice to the magnetic ions. The softening of the elastic constant $(\frac{1}{2})(C_{11}-C_{12})$ above the transition at 9.5°K is due to a strain coupling. This coupling dominates over the remaining biquadratic pair interactions of comparable magnitudes but opposite signs. The bilinear coupling was determined by fitting the magneto-thermal data below the ordering temperature. It is found that in DySb the biquadratic coupling is as important as the bilinear. (auth)

25150 DETERMINATION OF DOMAIN WALL ENERGIES IN RARE EARTH-COBALT COMPOUNDS. Ratnam, D. V.; Welis, R. G. (Crucible Materials Research Center, Pittsburgh). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 10, 568-572(1973).

From 18th annual conference on magnetism and magnetic materials; Denver, Colorado, USA (28 Nov 1972). See CONF-721114-P1.

Domain wall spacing W as a function of crystal thickness T was measured both on the axial plane and on the basal plane of single-crystal $SmCo_5$ specimens and, as expected, W values were larger for the axial plane domain structures. W vs T relationships were obtained for several rare earth cobalt compounds ($SmCo_5$, Sm_2Co_{17}, $PrCo_5$, and $CeCo_5$) from axial plane domain structures on single-crystal particles. Domain wall energy was calculated from the experimental data and also from a theoretical expression and the results correlate well. (auth)

25151 WALL-PINNING MODEL FOR THE COERCIVE FORCE IN MULTIDOMAIN SINGLE-CRYSTAL (RARE EARTH) Co_5 ALLOYS. Searle, C. W.; Frederick, W. G. D.; Garrett, H. J. (Air Force Materials Lab., Wright-Patterson AFB, OH). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 10, 573-577(1973).

From 18th annual conference on magnetism and magnetic materials; Denver, Colorado, USA (28 Nov 1972). See CONF-721114-P1.

It is found that several RCo_5 alloys (R = Y, Sm, or $Nd_{1-x}Sm_x$), prepared as single crystals, exhibit an intrinsic wall pinning coercive force, H_i. The data lead to a model which consists of a periodic pinning structure with a period about an order of magnitude larger than the period associated with the crystalline lattice. (auth)

25152 MAGNETIC PHASE ANALYSIS OF $RECo_5$ PERMANENT MAGNETIC MATERIALS. Menth, A.; Bachmann, K. (Brown Boveri Research Center, Baden, Switzerland). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 10, 578-581(1973).

From 18th annual conference on magnetism and magnetic materials; Denver, Colorado, USA (28 Nov 1972). See CONF-721114-P1.

Annealing at 1170°K often improves the performance of $SmCo_5$ permanent magnets. Thermomagnetic analysis show that this 1170°K annealing reduces the Sm_2Co_{17} and free Co phases, and that sufficient Sm needs to be present. This effect also applies to other $RECo_5$ magnet materials, and an explanation is offered on the basis of the Sm–Co phase diagram. The RE_2Co_7 phase reduces the magnetic moment and the RE_2Co_{17} phase seems to destroy the coercive force. (DLC)

25153 COBALT–SAMARIUM PERMANENT MAGNET ALLOYS: VARIATION OF LATTICE PARAMETERS WITH COMPOSITION AND TEMPERATURE. Martin, D. L.; Benz, M. G.; Rockwood, A. C. (General Electric Co., Schenectady, NY). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 10, 583-587(1973).

From 18th annual conference on magnetism and magnetic materials; Denver, Colorado, USA (28 Nov 1972). See CONF-721114-P1.

X-ray lattice parameters, chemical composition, phase identification by metallography, and magnetic properties were measured for a series of closely spaced compositions, in order to determine the phases present at the optimum composition. From these observations, the peak magnetic properties occur when the composition is hyperstoichiometric; i.e., close to the $Co_5Sm-Co_7Sm_2$ phase boundary as determined by x-ray measurements, 16.85 at.% Sm as determined by measurements of the chemical composition. In addition, changes in lattice parameter with temperature over the range 77 to 300°K are reported. (auth)

25154 DOMAIN WALL-PINNING CENTERS, PARTICLE SIZE, AND COERCIVITY DISTRIBUTIONS IN $SmCo_5$. McCurrie, R. A. (Univ. of Bradford, Eng.). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 10, 588-592(1973).

From 18th annual conference on magnetism and magnetic materials; Denver, Colorado, USA (28 Nov 1972). See CONF-721114-P1.

The distribution of intrinsic coercivities in a powder specimen of $SmCo_5$ was shown to be approximately normally distributed with a mean of 9700 Oe and a standard deviation of 3880 Oe. The particle size distribution in the specimen was measured from scanning electron micrographs and was shown to be log-normal with a mean particle size of 0.8 μm. Since the log-normal distribution has high positive skewness it appears that there is no simple relationship between the intrinsic coercivity and particle size, so that particles with a given size do not have identical coercivities. Measurements were also made on the effects of etching on the dimensions of the domain wall pinning centers. From the linear variation of the coercivity with temperature it has been estimated that the diameter of the pinning centers is ~20Å or 15 Å depending on the value of the wall energy per unit area. The estimates are the same for both the etched and unetched specimens although the coercivity was increased by as much as 60% after etching the $SmCo_5$ particles in 1% HNO_3 for 8 min. (auth)

25155 INTRINSIC MAGNETIC PROPERTIES AND MECHANISM OF MAGNETIZATION OF Co–Fe–Cu–R PERMANENT MAGNETS. Nesbitt, E. A.; Chin, G. Y.; Hull, G. W.; Sherwood,

R. C.; Green, M. L.; Wernick, J. H. (Bell Telephone Labs., Murray Hill, NJ). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 10, 593-597(1973).

From 18th annual conference on magnetism and magnetic materials; Denver, Colorado, USA (28 Nov 1972). See CONF-721114-P1.

The anisotropy constant K_u and the intrinsic coercive force $_MH_c$ were determined in the temperature range 4.2 to 297°K on a single crystal of $Co_{3.5}Fe_{0.5}CuCe_{1.05}$. Also, a magnetization curve was obtained on a thermally demagnetized sample of this composition in which domain walls were present. It was necessary for the applied field to reach the value of the coercive force to substantially change the magnetization. As a result of these magnetic measurements and the direct observation of the precipitate particles by Leamy and Green using transmission electron microscopy, it appears that the magnetization process is governed by domain wall pinning. (auth)

25156 INSTABILITY OF SOME $Ce_2(Co_{1-x}Fe_x)_{17}$ PHASES. Ray, A. E.; Strnat, K. J.; Harmer, R. S.; Hartings, M. S. (Univ. of Dayton, OH). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 10, 613-617(1973).

From 18th annual conference on magnetism and magnetic materials; Denver, Colorado, USA (28 Nov 1972). See CONF-721114-P1.

The magnetic and metallurgical properties of $R_2(Co, Fe)_{17}$ intermetallic phases are being studied and several were found to have promising permanent magnet properties. It was observed, however, that $Ce_2(Co_{1-x}Fe_x)_{17}$ phases with $0.4 \leq x \leq 0.8$ become unstable below 820 to 880°C, decomposing by the eutectoid reaction $Ce_2(Co_{1-x}Fe_x)_{17} \rightarrow a\ Ce_2(Co_{1-y}Fe_y)_7 + b\ Co_{1-z}Fe_z$. It is postulated that the instability results from mechanical stresses induced by forced ferromagnetic alignment of certain Fe atoms occupying sensitive positions in the $Ce_2(Co_{1-x}Fe_x)_{17}$ structure. (auth)

25157 MAGNETIC PROPERTIES OF THE INTERMETALLIC PHASES $Sm_2(Co, Fe)_{17}$. Mildrum, H. F.; Hartings, M. S.; Strnat, K. J.; Tront, J. G. (Univ. of Dayton, OH). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 10, 618-622(1973).

From 18th annual conference on magnetism and magnetic materials; Denver, Colorado, USA (28 Nov 1972). See CONF-721114-P1.

Saturation magnetization values and uniaxial anisotropy constants at 20°C, also Curie points and other magnetic transition temperatures are reported for the alloys $Sm_2(Co_{1-x}Fe_x)_{17}$ as a function of x. For x = 0.3 to 0.7, the 2 : 17 phase is probably metastable at room temperature. Saturation has a peak of ~16300 G at x = 0.7. Easy-axis anisotropy prevails from x = 0 to ~0.5. Anisotropy fields between 108 kOe (x = 0.1) and ~40 kOe (x = 0.4) were determined. T_c > 800°C in this range. These results substantiate the previously made claim that Co-rich alloys in this system hold the promise of new permanent magnets that could be superior to $SmCo_5$. (auth)

25158 MAGNETIC PROPERTIES OF THE INTERMETALLIC PHASE $MM_2(Co_{0.7}Fe_{0.3})_{17}$. Tsui, J. B. Y.; Mildrum, H. F.; Strnat, K. J.; Shanley, C. W. (Univ. of Dayton, OH). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 10, 623-627(1973).

From 18th annual conference on magnetism and magnetic materials; Denver, Colorado, USA (28 Nov 1972). See CONF-721114-P1.

The alloy $MM_2(Co_{0.7}Fe_{0.3})_{17}$, where MM is Ce-rich mischmetal, was studied with view toward its possible utility for permanent magnets or recording media. Its saturation magnetization is 14.8 kG at 20°C, the Curie temperature 750°C. The easy direction of magnetization is along, or close to, the hexagonal c-axis, and the uniaxial crystal anisotropy constants are $K_1 + K_2 \approx 4 \times 10^6$ erg/cm^3. Fine powders were prepared by several different processes, their coercive force measured and related to particle size and treatment. Micro-powders made by ballmilling have $_MH_c$ = 316 Oe. Chemical etching of the particles increases $_MH_c$ to 435 Oe. (auth)

25159 MAGNETIC PROPERTIES OF THE TERNARY SYSTEMS Pr-Sm-Co AND MM-Sm-Co. Das, D. K. (Raytheon Co., Waltham, MA). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 10, 628-632(1973).

From 18th annual conference on magnetism and magnetic materials; Denver, Colorado, USA (28 Nov 1972). See CONF-721114-P1.

Coercivity in the ternary Pr-Sm-Co and MM-Sm-Co was measured as a function of composition over a broad range. It was found to increase monotonically with samarium content. These results including the special role of samarium are interpreted in terms of recent models of coercive force in rare earth-cobalt magnets. (auth)

25160 PRESENT UNDERSTANDING OF COERCIVITY IN COBALT-RARE EARTHS. Livingston, J. D. (General Electric Co., Schenectady, NY). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 10, 643-657(1973).

From 18th annual conference on magnetism and magnetic materials; Denver, Colorado, USA (28 Nov 1972). See CONF-721114-P1.

Theory and experiments relating to coercivity in cobalt-rare earth compounds are reviewed. Coercivity is predominantly limited by the nucleation of reverse domains by defects. Domain-wall pinning also influences coercivity in some cases. The specific defects responsible for domain nucleation have not been conclusively identified, but may be cobalt-rich regions and deformation-induced dislocations and stacking faults. (8 figures, 83 references) (auth)

25161 MAGNETOCRYSTALLINE ANISOTROPY IN CUBIC RARE EARTH-Fe_2 COMPOUNDS. Clark, A. E. (Naval Ordnance Lab., Silver Spring, MD); Belson, H. S.; Tamagawa, N. AIP (Amer. Inst. Phys.) Conf. Proc.; No. 10, 749-753(1973).

From 18th annual conference on magnetism and magnetic materials; Denver, Colorado, USA (28 Nov 1972). See CONF-721114-P1.

Magnetization and magnetic torque measurements were made on single crystals of $ErFe_2$ from 77 to 329°K. From these measurements, the magnetocrystalline anisotropy constants were deduced. At room temperature $K_1 = -3.3 \times 10^6$ ergs/cm^3; at 77°K, $-K_1 > 10^8$ ergs/cm^3. Huge magnetic anisotropies are predicted for $TbFe_2$ and $DyFe_2$, whereas small anisotropies are predicted for ternary $Tb_xDy_{1-x}Fe_2$ compounds near x = 0.3. The magnetostriction in this compound saturates easily, indicating low anisotropy. Theoretical anisotropics are also estimated for $HoFe_2$ and $TmFe_2$. (4 figures, 2 tables) (auth)

25162 EFFECT OF MAGNETOELASTIC INTERACTIONS ON ELASTIC CONSTANTS OF HEAVY RARE EARTH METALS. Southern, B. W.; Goodings, D. A. (McMaster Univ., Hamilton, Ont.). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 10, 754-758 (1973).

From 18th annual conference on magnetism and magnetic materials; Denver, Colorado, USA (28 Nov 1972). See CONF-721114-P1.

A theory employing finite strains and angular momentum invariants is applied to the rare earth metals of hcp structure. A Hamiltonian is written down which is invariant under combined rotations of the magnetic and elastic systems. When the usual small strain approximations are subsequently made, there appear new terms linear in the antisymmetric strains. The coupling of transverse acoustic waves to the magnetic system is studied and expressions obtained for the dependence of the elastic constants c_{44} and c_{66} on an applied magnetic field in the ferromagnetic phase. Estimates of the effects to be expected for Gd, Tb, Dy, Ho, and Er indicate that it should be possible to obtain in a direct manner the values of certain magnetoelastic constants and anisotropy constants. Calculations have also been performed for the field-dependent changes in c_{11} and c_{33} for longitudinal waves in the paramagnetic region. These changes result from the fact that the finite strains $E_{\mu\mu}$ include terms of the form $\epsilon_{\mu\mu}^2$. (auth)

25163 HIGH-FIELD ANISOTROPY AND MAGNETIZATION OF SINGLE CRYSTAL DYSPROSIUM. Graham, C. D. Jr. (Univ. of Pennsylvania, Philadelphia); Flanders, P. J.; Egami, T. AIP (Amer. Inst. Phys.) Conf. Proc.; No. 10, 759-763(1973).

From 18th annual conference on magnetism and magnetic materials; Denver, Colorado, USA (28 Nov 1972). See CONF-721114-P1.

Torque measurements made on a (0001) single crystal disk of Dy from 77 to 150°K, and in fields up to 130 kOe, give a six-fold anisotropy K_6^6 that increases rapidly with increasing field. Magnetization measurements show no difference in magnetization between the a and b directions in this temperature range; therefore the field dependence of the anisotropy is not due to anisotropic magnetization. The magnetization can be significantly changed by applied field as well as by temperature in the temperature range studied here. The anisotropy is found to be a single-valued function of the magnetization, whether the magnetization is changed by applied field or by temperature. The experimental data are reasonably well represented by the equation $K/K_0 = (\sigma/\sigma_0)^{12}$. (auth)

25164 ELASTIC-WAVE GENERATION IN Dy, Tb, Gd, AND Tb-Fe FILMS. Donoho, P. L. (Rice Univ., Houston, TX); Benningfield, L. V.; Wunsch, P. K.; McLane, L. B.; Blackstead, H. A. AIP (Amer. Inst. Phys.) Conf. Proc.; No. 10, 769-773(1973).

From 18th annual conference on magnetism and magnetic materials; Denver, Colorado, USA (28 Nov 1972). See CONF-721114-P1.

The magnetostrictive generation of elastic waves was observed in thin films of Dy, Tb, and Gd, and in thin films of nominal composition $TbFe_2$. Elastic-wave generation in these materials was

observed at frequencies between 690 and 1550 MHz, at temperatures from 4.2°K up to the magnetic ordering temperatures in the case of Dy and Tb films, and at temperatures up to 350°K in the case of the Tb–Fe films. Elastic-wave generation in the Gd films could not be observed above approximately 50°K. In all cases, only transverse elastic waves were observed, in contrast with the earlier work of Maley et al. The greatest efficiency of elastic-wave generation in the pure rare-earth films was observed in the case of Dy at 4.2°K. Strong elastic-wave generation was observed in the Tb–Fe films at room temperature and above, but the maximum efficiency in this case was observed at approximately 200°K. (auth)

25165 GENERATION OF GIGAHERTZ PHONONS IN DYSPROSIUM FILMS. Elliott, M. T.; Wang, J. T.; Blackstead, H. A. (Univ. of Notre Dame, IN). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 10, 774-778(1973).

From 18th annual conference on magnetism and magnetic materials; Denver, Colorado, USA (28 Nov 1972). See CONF-721114-P1.

A tuneable spin-phonon spectrometer was used to investigate the generation of microwave phonons in films of dysprosium for frequencies varying from 10 to 32 GHz. The films, whose thicknesses were varied from 0.5 to 2.4 μm, were evaporated onto one end of the phonon detector, a rectangular rod of SrF_2 doped with Tm^{2+}. Static and rf magnetic fields were applied in the plane of the sample, and in addition to biasing the sample, the static field was used to tune the spectrometer. A simple analysis, based on the free lattice model proposed to describe dynamic magnetoelastic effects in rare earth metals, shows that phonons should be generated at the rf field frequency, ν_0, and with a smaller intensity at 2 ν_0. Phonons at ν_0 were extensively studied and it was found that the phonon signal depends on the intensity of the rf field, as would be expected, but is very insensitive to the angle between the rf and static fields. Evidence exists for broad phonon generation at 2 ν_0. (auth)

25166 LOCAL MOMENT FORMATION AND MAGNETIC INTERACTIONS IN W(Fe) AND W–Ta(Fe) ALLOYS. Thomas, L. K. (Massachusetts Inst. of Tech., Cambridge); Sellmyer, D. J. AIP (Amer. Inst. Phys.) Conf. Proc.; No. 10, 806-810(1973).

From 18th annual conference on magnetism and magnetic materials; Denver, Colorado, USA (28 Nov 1972). See CONF-721114-P1.

In W(Fe), evidence for magnetization contributions from isolated Fe atoms and ferromagnetically coupled Fe atoms was obtained. Susceptibility maxima at low temperatures suggest magnetic transitions of a spin-glass nature. Adding Ta to W(Fe) has the effect of diminishing the local moment magnetism. (6 figures) (auth)

25167 ENTHALPY OF NIOBIUM IN THE SOLID AND LIQUID STATE. Sheindlin, A. E.; Berezin, B. Y.; Chekhovskoi, V. Y. (Inst. of High Temperature, Moscow). High Temp. - High Pressures; 4: No. 6, 611-619(1972).

The enthalpy of niobium was measured by drop calorimetry using induction heating of samples in an electromagnetic "crucible" and a copper block calorimeter with an isothermal shell. The enthalpy of solid niobium was measured in the temperature range 1650 to 2707°K and of liquid niobium in the range 2742 to 2753°K. The enthalpy data for solid and liquid niobium yield 6597 ± 170 cal mol^{-1} as its latent heat of fusion. The spectral normal emissivity of liquid niobium at the melting point at 0.650 μm was found to be 0.363 ± 0.022. The accuracy of the results is analyzed. (auth)

25168 HIGH-TEMPERATURE THERMOPHYSICAL PROPERTIES OF TUNGSTEN. Hoch, M. (Univ. of Cincinnati). High Temp.–High Pressures; 4: No. 6, 659-661(1972).

From third European conference of thermophysical properties; Turin, Italy (20 Jan 1972).

High-temperature specific-heat data for tungsten, obtained in various laboratories using both calorimetry and extremely rapid transient techniques are compared and evaluated. The data are shown to agree within 1%, confirming a previously developed equation for the specific heat of tungsten between room temperature and the melting point, $C_P = 3RF(\theta_D/T) + 1.67\times10^{-3}T + 4.27\times10^{-10}T^3$ (J $mol^{-1}K^{-1}$). Similarly comparison of values of the total emittance ϵ, measured by various methods and also computed from electrical resistivity measurements, reveals close agreement at high temperatures and moderate disagreement at lower temperatures. Between 2000°K and the melting point, the ratio of specific heat to total emittance C_P/ϵ has a constant value of 128 ± 3 J $mol^{-1}K^{-1}$. (auth)

25169 ZIRCONIUM. Phases and Compressibility to 120 Kilobars. Olinger, B. (Los Alamos Scientific Lab., N. Mex.); Jamieson, J. C. High Temp.–High Pressures; 5: No. 2, 123-131(1973).

The compressional behavior of zirconium metal in both its hcp α phase and its hexagonal ω phase was studied with x-ray-diffraction techniques. The data are in excellent agreement with shock-wave studies and Bridgman's studies (Proc. Amer. Acad. Arts Sci. 76: 71-87 and 55-70 (1948), and 81: 165-251 (1953)) up to 98 kbar when zirconium was found to undergo a phase transition from α to ω. (auth)

25170 ANOMALOUS BEHAVIOUR DURING INTERDIFFUSION IN THE SYSTEM Nb–Mo. Brunsch, A.; Krabichler, T.; Steeb, S. (Max-Planck-Institut fuer Metallforschung, Stuttgart). High Temp.–High Pressures; 5: No. 2, 199-206(1973).

Investigation of interdiffusion in the system Nb–Mo shows an anomalous behaviour, according to Kidson's model (Can. J. Phys. 41: 1563 (1963)). Surface and grain-boundary diffusion can be neglected. The interdiffusion coefficient measured at temperatures from 1200 to 1900°C shows a major deviation from Arrhenius behaviour and can be expressed as a sum of exponentials. This result is compared with those of other workers. The concentration dependence of the activation energies and frequency factors is also given. The diffusion layer grows according to a parabolic law. The temperature dependence of the growth constant shows the same anomaly as do the diffusion coefficients. The values obtained for activation energies of growth are in good agreement with those of diffusion. (auth)

25171 SUPERCONDUCTIVITY, STRUCTURE, AND MAGNETIC SUSCEPTIBILITY OF $Nb_\gamma Au_\chi Pt_{1-\chi}$ A15- TYPE PHASES. Khan, H. R.; Roeschel, E.; Raub, C. J. (Forschungsinstitut fuer Edelmetalle und Metallichemie, Schwaebisch Gmuend, Ger.). Z. Phys.; 262: No. 4, 279-293(1973).

Measurements of the superconducting transition temperature, lattice parameter, and magnetic susceptibility were made on ternary Nb–Au–Pt alloys in as-cast and annealed conditions. Annealing reduced most of the alloys to A15 structure as observed by x-ray diffraction, but metallographic microstructures of some of these alloys showed them to be still inhomogeneous. This inhomogeneity affects the values of T_c and χ. All the alloys are found to be nearly paramagnetic in nature, and χ follows the variation in T_c for most of all the alloys. The experimental results are discussed in their relationship to other low-temperature properties, e.g., the electron–phonon interaction constant, electron density of states, and lattice volume. (GE)

25172 PROPERTIES OF LIQUID METALS. Proceedings of the Second International Conference, Tokyo, Japan, September 3-8, 1972. Takeuchi, S. (ed.). New York; John Wiley and Sons, Inc. (1973). 661p. (CONF-720996–). $35.00.

About 100 papers were presented at the conference. A separate abstract was prepared for six papers. Papers for which no abstracts were prepared are concerned with structure of liquid metals and alloys, thermodynamic properties of liquid metals and alloys, and melting phenomena of metals. (JRD)

For abstracts of individual papers see: 25134–25138, and 25173.

25173 IMMISCIBILITY OF LIQUID Li–Na ALLOYS. Tamaki, S. (Niigata Univ., Japan). pp 455-460 of Properties of Liquid Metals. Takeuchi, S. (ed.). London; Taylor and Francis Ltd. (1973).

From international conference on the properties of liquid metals; Tokyo, Japan (3 Sep 1972).

The immiscibility of a liquid Li–Na alloy is discussed using the microscopic total energy based on a pseudopotential method. The effective pair potential seems to play an important role for immiscibility in the liquid Li–Na system. The heat of mixing of this system at miscible temperature is also calculated. (auth)

25174 INTERNAL FIELDS AND RELAXATION EFFECTS FOR Dy IN FERROMAGNETIC MATERIALS STUDIED BY PERTURBED ANGULAR CORRELATION TECHNIQUE. Waeppling, R.; Karlsson, E.; Carlsson, G.; Pernestaal, K. (Uppsala Univ.). Phys. Scr.; 8: No. 1-2, 73-80(1973).

The magnetic hyperfine field for Dy in $TbAl_2$ was measured in the temperature range 1.5 to 130°K using the PAC technique. Thermal equilibrium after the radioactive decay is not reached during the observation time ($\tau = 3.1\times10^{-12}$ s) and the effective field is therefore reduced. The role of electronic spin relaxation in PAC is discussed in detail. The relaxation time was measured between 4°K and room temperature and was found to be of the order of 10^{-12} s. The temperature variation of the hyperfine field is consistent with the trend expected from a molecular field model. (auth)

25175 MAGNETIC PROPERTIES OF HIGH PURITY SCANDIUM AND THE EFFECT OF IMPURITIES ON THESE PROPERTIES. Spedding, F. H.; Croat, J. J. (Ames Laboratory–USAEC and Department of Metallurgy, Iowa State

University, Ames, Iowa 50010). J. Chem. Phys. 58: No. 12, 5514-5526 (15 June 1973).

The magnetic susceptibility of single and polycrystalline Sc has been measured from approximately 1.5 to 300°K. The metal used is believed to be more thoroughly characterized and of significantly higher purity than that used in previous studies. Sc was found to exhibit excellent Curie–Weiss behavior above 70°K. A previously unreported maximum was found at 30°K. The effect of nonmagnetic impurities, including O, H, Ti, Zr, Hf, Nb, Ta, and Th, on the susceptibility of Sc was found to be quite pronounced. The behavior of dilute Gd and Er impurities in the Sc matrix was also investigated. (auth)

25176 ESTIMATES OF THE COULOMB CORRELATION ENERGY FROM X-RAY PHOTOEMISSION DATA. Hüfner, S.; Wertheim, G. K. (Bell Laboratories, Murray Hill, New Jersey 07974). Phys. Rev. B 7: No. 12, 5086-5090 (15 June 1973).

The experimental information available from x-ray photoemission spectroscopy regarding the electron correlation energy U of 3d and 4f electrons in solids is considered. It is found that U is of the order of 7 eV for 4f electrons and ≈2 eV for 3d electrons. (auth)

25177 INFLUENCE OF INTERSTITIALS ON THE PROPERTIES OF VANADIUM. Chang, H. Y. Urbana, IL; Univ. of Illinois (1972). 134p. University Microfilms Order No. 73-17,147.

Thesis (Ph. D.).

Effects of interstitials like oxygen, nitrogen and hydrogen on the low-temperature relaxation of deformed vanadium were studied. The oxygen and nitrogen atoms are immobile at temperatures below room temperature, whereas the hydrogen atoms are mobile. The difference in mobility of those interstitials has several effects on the relaxation involving dislocations. The α peak, the hydrogen cold-work peaks, and hydride precipitation peak were examined. The differences in nature among those relaxation peaks were explained by different interstitial contents, activation energies, and relaxation models. The solubility of hydrogen in vanadium was determined by internal friction techniques. The effects of oxygen, carbon, and nitrogen on the hydrogen solubility were also investigated with the purpose of explaining discrepancies in solubility among several previous investigators. These interstitial impurities are found to increase the hydrogen solubility, a phenomenon interpreted as being caused by the trapping of hydrogen by these interstitials. Each carbon or nitrogen atom can trap one hydrogen atom while oxygen can trap up to three hydrogen atoms. The binding energy of C–H and N–H pairs is about cal/mole. The binding energy of OH pair, OH_2 triplet, and OH_3 quadruplet is 1900, 5800, and 8700 cal/mole respectively. (Diss. Abstr. Int., B)

25178 CYCLIC MECHANICAL AND FATIGUE PROPERTIES OF FERROANELASTIC BETA PRIME GOLD–CADMIUM. Karz, R. S. Urbana, IL; Univ. of Illinois (1972). 131p. University Microfilms Order No. 73-17,274.

Thesis (Ph. D.).

Beta prime $Au_{1.05}Cd_{0.95}$ deforms up to strains of 0.076 at low stress levels by the reversible motion of twin boundaries (either present in lamellar twins introduced by a martensitic transformation or nucleated in response to stress) as opposed to deformation by slip in most other metals. In addition, this alloy exhibits the remarkable "rubber-like" behavior due to a volume restoring force which returns twin boundaries displaced by stress to their original positions when stress is removed. The fatigue behavior of this alloy was investigated and found to be exceptional for certain orientations with lives of 10^5 to 10^6 cycles at total strain amplitude ($\Delta\epsilon$) above 0.05 not uncommon. Fatigue lives were influenced principally by the stress level which controlled the amount of plastic deformation, and stress fatigue resistance was low compared with most metals. Failure always exhibited brittle characteristics. An algorithm was devised to predict mechanical behavior from the twin system orientations and was found in good agreement with experiment for longitudinal strains above 0.04. The cyclic mechanical properties were examined, and a model for the behavior was proposed utilizing previous theories of the restoring force and the Peierls–Nabarro stress for twinning and new concepts. Gold–cadmium was found to have certain strain fatigue-resistant applications, particularly in electronics where the alloy's high electrical conductivity is utilized and has promise in other "memory" systems. (Diss. Abstr. Int., B)

25179 PHASE EQUILIBRIA IN THE SYSTEM Zr–V–Ru. Akhverdyan, M. M.; Raevskaya, M. V.; Burnasheva, V. V.; Gladyshevskii, E. I.; Sokolovskaya, E. M. Vestn. Mosk. Univ., Ser. II. Khim.; 14: No. 2, 182-186(1973). (In Russian)

The ternary system Zr–V–Ru was investigated for the first time by x-ray and microscopic methods and by measurements of hardness and microhardness in the temperature range 900 to 1500°C. Annealed, quenched and as-cast alloys were studied. An isothermal cross section was obtained for the alloy annealed at 900°C. (auth)

25180 ANALYSIS OF SUSCEPTIBILITY AND MAGNETIZATION OF $REFe_2$ COMPOUNDS WITH MOLECULAR FIELD THEORY (RE = Gd, Tb, Dy, Ho, Er, and Tm). Hilscher, G.; Rais, H.; Kirchmayr, H. R. (Technische Hochschule, Vienna). Phys. Status Solidi (b); 59: No. 1, K5-K9(1 Sep 1973). (In German).

The question to what degree the magnetic moment of Fe can be considered as localized is studied, and the temperature dependence of the magnetization is described. Sublattice and total magnetization are calculated for the RE and Fe atoms and compared with measured total magnetization for $TbFe_2$, $DyFe_2$, $HoFe_2$, and $TmFe_2$. Molecular field coefficients γ_{AA}, γ_{AB}, and γ_{BB} are tabulated for $GdFe_2$, $TbFe_2$, $DyFe_2$, $HoFe_2$, $ErFe_2$, and $TmFe_2$; they show that γ_{BB} dominates. (DLC)

25181 YTTERBIUM–PALLADIUM SYSTEM. Iandelli, A.; Palenzona, A. (Univ., Genoa). Rev. Chim. Miner.; 10: No. 1, 303-308(1973).

The Yb–Pd phase diagram was determined. The possible behavior of Yb as a divalent or a trivalent element in the intermetallic phase leads to division of the phase diagram into two distinct parts: up to 50 at.% Pd, where Yb behaves as a divalent metal giving two combinations, Yb_3Pd and Yb_5Pd_2; between 50 and 100 at.% Pd, where five intermediate phases all containing Yb(III) exist. (FR)

25182 STUDY OF MAGNETIC PHASE TRANSITIONS IN POLYCRYSTALLINE TERBIUM BY MEANS OF POLARIZED NEUTRONS. Baazov, N. G.; Barash, Ya. M.; Kolesnikova, L. M.; Shilo, S. I. (Inst. of Physics, Tbilisi, USSR). Soobshch. Akad. Nauk Gruz. SSR; 71: No. 2, 333-336(Aug 1973). (In Russian).

Depolarization of neutrons in polycrystalline terbium in the heating–cooling cycle near the magnetic phase transition points Θ_1 and Θ_2 was investigated. A temperature hysteresis of depolarization near Θ_1 and a maximum near Θ_2, as well as the temperature transition dependence on the temperature change rate, was found. Some time relaxation effects were measured. An assumption about the mixed character of the transition near Θ_2 is made. (auth)

25183 EFFECT OF RARE EARTH METALS ON CHROMIUM VAPORIZABILITY. Mikadze, O. I.; Tavadze, F. N.; Rudoi, A. P.; Pogrebnyak, V. I.; Mel'nik, V. Kh. (Inst. of Physics, Tbilisi, USSR). Scobshch. Akad. Nauk Gruz. SSR; 71: No. 2, 409-412 (Aug 1973). (In Russian).

Effects of cerium, lanthanum, praseodymium, and yttrium on the evaporation kinetics of chromium in vacuo in the temperature range of 1050 to 1250°C were investigated. (auth)

25184 MEASUREMENT OF SPIN–LATTICE RELAXATION TIMES SHORTER THAN 10^{-8} S: APPLICATION TO $CuSO_4 \cdot 5H_2O$ AND Gd METAL. Gourdon, J. C.; Vigouroux, B.; Pescia, J. (Univ. Paul Sabatier, Toulouse). Phys. Lett., 45A: No. 1, 69-70 (27 Aug 1973).

An improvement of the modulation method is presented. The direct measurement of T_1 becomes possible, however short it might be. Application is made to $CuSO_5 \cdot 5H_2O$ at 295°K and to Gd metal at 350°K. (auth)

25185 MAGNETIC HYPERFINE FIELD AT Cd NUCLEI IN THE RARE EARTH FERROMAGNETS Gd, Tb, Dy, Ho, Er, AND Tm. Forker, M.; Hammesfahr, A. (Univ., Bonn). Z. Phys.; 263: No. 1, 33-47(1973).

The time-differential perturbed angular correlation technique was used to study the combined magnetic and electric hyperfine interactions at the site of a ^{111}Cd impurity at 4.2°K. The following magnetic hyperfine fields were found: $(H_{hf}) = 340(7)$ kG in Gd, 275(5) kG in Tb, 221(4) Kg in Dy, 116(3) kG in Er, and 60(6) kG in Tm. In Ho, two magnetically different sites were observed with magnetic fields of 159(3) and 139(3) kG. Both sites are equally populated. The coupling constant J_{sf} of the conduction electron–4f interaction was calculated from the measured hyperfine fields by means of the RKKY theory. (GE)

25186 MAGNETIC PROPERTIES OF URANIUM COMPOUNDS OF LOW URANIUM CONTENTS: UCu_5, U_2Zn_{17}, AND UCd_{11}. Misiuk, A.; Mulak, J.; Czopnik, A. Bull. Acad. Pol. Sci., Ser. Sci. Chim.; 21: No. 6, 487-493(1973).

The magnetic properties of UCu_5, U_2Zn_{17}, and UCd_{11} were investigated over the temperature range 4.2 to 900°K. UCu_5 exhibits an antiferromagnetic transition at 15°K. The temperature-independent paramagnetism of U_2Zn_{17} and UCd_{11} at the lowest temperatures indicates the nonmagnetic ground level of uranium.

The magnetic properties of the investigated compounds are interpreted in terms of the crystal-field model assuming $^3H_4$ term as a ground term of uranium. The crystal-field Hamiltonians of UCu_5 and UCd_{11} were determined. (3 figures) (auth)

25187 VOID NUCLEATION DURING THERMAL CYCLING OF ADJUSTED URANIUM. Lobb, R. C. (Central Electricity Generating Board, Berkeley, Eng.). J. Nucl. Mater.; 48: No. 1, 67-73(Aug 1973).

The nucleation of voids in adjusted uranium during thermal cycling between 400 and 600°C and during rapid quenching from the β-phase was studied, using an accurate density measuring technique and scanning electron microscopy. Voids are observed to nucleate at carbide inclusion/matrix interfaces before subsequent void growth occurs intergranularly. The length of the transient period between intragranular nucleation and intergranular growth is 300 cycles for adjusted uranium specimens cycled between 400 and 600°C. A model for void nucleation based upon parting at the inclusion/matrix interface as a result of interfacial strains set up by the differential expansion of the carbide inclusion and surrounding matrix is proposed. (auth)

25188 THERMAL DIFFUSIVITY OF ARMCO IRON, TUNGSTEN, AND MOLYBDENUM AT VERY HIGH TEMPERATURES. Weilbacher, J. C.; Van Craeynest, J. C.; Fauxinstier, J.; Boy, J. J. (CEN, Fontenay-aux-Roses, France). Rev. Int. Hautes Temp. Refract.; 10: No. 2, 77-78(Apr 1973). (In French).

The thermal diffusivities of Armco iron (up to its melting point) and tungsten and molybdenum (both up to 2,400 deg) were measured in view of calibrating thermal-diffusivity measurement equipment at the CEN Fontenay-aux-Roses. The results obtained show a good agreement between the measurements effected at low temperatures (Angstroem method) and those effected at high temperatures (Cowan method). Most of the values obtained for the thermal diffusivity were in agreement with values cited in the literature. The variations in the diffusivity were determined in the region of the allotropic transformations of Armco iron. (auth)

25189 MELTING POINT OF MOLYBDENUM AS A SECONDARY FIXED POINT ON THE INTERNATIONAL PRACTICAL TEMPERATURE SCALE. Kenisarin, M. M.; Berezin, B. Y.; Chekhovskoi, V. Y. (Inst. of High Temperature, Moscow). High Temp.-High Pressures; 4: No. 6, 707-713(1972).

From 3rd European conference on thermophysical properties; Turin, Italy (20 Jun 1972).

The melting point of molybdenum was measured at the instant of the appearance of the first drop of molten metal in a blackbody cavity in the specimen. The specimens were placed in a tantalum tube and hf heated in an argon atmosphere. The temperature was measured with two suitably calibrated disappearing-filament reference pyrometers. The melting point of molybdenum was found to be 2626°C ± 9 K (IPTS-68). Statistical treatment of the new data and those of other authors yields a mean value for the melting point of molybdenum of 2623°C ± 8 K (IPTS-68), which is recommended as a secondary reference point on the temperature scale. (auth)

25190 POINT CORRELATION OF ELECTRONS IN MIXTURES OF T^4 ELEMENTS. Schubert, K. (Max-Planck-Institut fuer Metallforschung, Stuttgart). J. Less-Common Metals; 33: No. 1, 1-23(Oct 1973). (In German).

From the crystal structures of phases in mixtures of the transition metals of the fourth homologous class of the periodic system, it can be inferred that two spatial correlations of electrons are responsible for the type of the structure: the correlation of the conduction electrons and the correlation of the outer core electrons. Certain types of correlations are probable as they provide commensurability with the crystal cell. On the other hand the correlations afford rules for the appearance of certain structures. (9 tables, 22 references) (auth)

25191 X-RAY- AND NEUTRON-DIFFRACTION STUDY OF ORDERING ON CRYSTALLOGRAPHIC SITES IN RARE-EARTH-BASE ALLOYS CONTAINING ALUMINIUM AND TRANSITION METALS. Oesterreicher, H. (Oregon Graduate Center, Beaverton). J. Less-Common Metals; 33: No. 1, 25-41(Oct 1973).

Ordering tendencies on crystallographic sites are studied by x-ray and neutron diffraction on compounds with a rare-earth basis with transition metals (Fe and Co) and Al. Materials studied in detail include Al-substituted phases $ErCo_2$, $DyFe_2$, Tb_2Fe_{17}, and $PrCo_5$, as well as ternary phases ErCoAl and DyFeAl. In all cases studied, the rare earths solely occupy one set of crystallographic sites. In rare-earth binaries with a transition-metal basis, Al substitution takes place at random on transition-metal sites. Ordering tendencies are observed in the homogeneous regions of ternaries, the most pronounced one being ErCoAl and LuCoAl which, at compositions corresponding to R_2CoAl_3, crystallize with a superstructure of the $MgZn_2$ type. A different type of ordering tendency is observed in the Fe analog ternaries. (6 tables, 19 references) (auth)

25192 CRYSTAL STRUCTURE AND MAGNETIC PROPERTIES OF SOME 7:3 BINARY PHASES BETWEEN LANTHANIDES AND METALS OF THE 8TH GROUP. Olcese, G. L. (Univ., Genoa). J. Less-Common Metals; 33: No. 1, 71-81(Oct 1973).

The crystal structures of the 7:3 phases of the RE–T systems, where T is an element of the 8th Group, were investigated by metallographic and x-ray methods. The occurrence of a 7:3 phase of the Th_7Fe_3-structure type was found in 25 systems. A study of the stability of this phase carried out for the RE–Ni and RE–Rh systems leads to the conclusion that in the binary systems with Ni, its occurrence is restricted to the lighter RE elements (La, Ce, Pr, and Nd), while in the systems with Rh the phase exists for every RE metal examined (La, Ce, Pr, Nd, Sm, Gd, Tb, Dy, Ho, Er). Crystallographic data at room temperature and magnetic properties in the temperature range 77–500°K for 25 compounds are reported. (8 figures, 18 references) (auth)

25193 MOESSBAUER AND X-RAY STUDIES OF THE MAGNETIC PROPERTIES AND CRYSTAL STRUCTURE OF THE PHASE PdEu. Longworth, G. (Atomic Energy Research Establishment, Harwell, Eng.); Harris, I. R. J. Less-Common Metals; 33: No. 1, 83-90(Oct 1973).

^{151}Eu Moessbauer spectra are measured in the equiatomic compound PdEu as a function of temperature. A value for the saturation hyperfine field at the europium sites of –160 ± 2 kOe is obtained and the ordering temperature is determined to be 48 ± 2°K. Measurements in an applied magnetic field of 60 kOe are discussed in terms of the possible types of magnetic ordering present. The crystal structure of PdEu is shown to be orthorhombic, CrB type. (auth)

25194 NEW FCC GADOLINIUM PHASE AND ITS OXIDATION. Bist, B. M. S.; Srivastava, O. N. (Banaras Hindu Univ., India). J. Less-Common Metals; 33: No. 1, 99-103(Oct 1973).

A new polymorphic phase, characterized by a face-centered cubic structure with lattice parameter 5.35 ± 0.02 Å, was identified in thin films of gadolinium. The oxidation characteristics of this new phase are briefly described and discussed. (auth)

25195 EFFECTS OF INTERSTITIAL SOLUTE ADDITIONS ON THE MECHANICAL PROPERTIES OF NIOBIUM AND TANTALUM SINGLE CRYSTALS. Ulitchny, M. G.; Gibala, R. (Case Western Reserve Univ., Cleveland). J. Less-Common Metals; 33: No. 1, 105-116(Oct 1973).

The influence of binary and ternary additions of oxygen and nitrogen on the mechanical behavior of niobium and tantalum single crystals is investigated. Additions of either oxygen or nitrogen to high-purity crystals cause only alloy hardening in both the thermal and athermal temperature regimes. The same additions to less-pure crystals or to high-purity crystals intentionally doped with a second interstitial, result in alloy softening in the thermal component of the yield stress. The strain-rate sensitivity varies with interstitial content in the same manner as the yield stress, whether alloy hardening or softening is observed. These results are interpreted in terms of effects that solute interactions exert on thermally activated interstitial hardening in niobium and tantalum. (7 figures, 34 references) (auth)

25196 DEFORMATION MECHANISMS OF UNALLOYED NIOBIUM AT LOW TEMPERATURE (20 to 300 K). Fries, J. F.; Houssin, B.; Cizeron, G.; Lacombe, P. (Institut National des Sciences et Techniques Nucleaires, Saclay, France). J. Less-Common Metals; 33: No. 1, 117-152(Oct 1973). (In French).

After studying the different fundamental mechanisms that could control the plastic deformation of a bcc metal at low temperatures, it is shown that the Peierls–Nabarro and Escaig–Hirsch models enable one to interpret satisfactorily the plastic behavior of polycrystalline niobium at low temperatures. These two models in fact lead to a linear relationship between the activation energy and the temperature. The results are in agreement with this conclusion up to a temperature of about 195 to 210°K (according to the purity of the metal). The low values found for the activation volume (less than 10 b^3), confirm that it is concerned with an intrinsic resistance by friction to the movement of dislocations. The values of line tension and critical distance between the kinks, calculated from the Peierls–Nabarro model, are identical for the four purities and are perfectly compatible with the values already published for other body-centered metals (Fe, Ta, V...). On the basis of the Escaig–Hirsch model, an approximate value of the stacking-fault energy of about 90 ergs/cm^2 was obtained, in agreement with their estimations. On the other hand, the law of the variation of H with $1/\tau^*$, proposed by Escaig for the temperatures less than about

100°K is equally applicable to the results. (20 figures, 136 references) (auth)

Radiation Effects

Refer also to abstracts 24960, 26408, 26515, and 26529.

25197 (AD-757653) COOPERATIVE RADIATION-EFFECTS SIMULATION PROGRAM. Semiannual Progress Report, 1 May–31 October 1972. Steele, L. E.; Wolicki, E. A. (Naval Research Lab., Washington, D. C.). Feb 1973. 81p. (NRL-MR-2555). NTIS.

The goal of the research is to provide the theoretical and experimental bases for understanding the mechanisms of void nucleation and growth and the influence of helium on both mechanical properties and void nucleation, as well as a theoretical insight into energy deposition processes. In this program, the Van de Graaff and cyclotron are used to rapidly simulate the radiation damage produced over long operating periods in reactor-neutron environments. The progress report includes: (1) an electron microscopy analysis of nickel-ion bombarded nickel, (2) studies using small-angle x-ray scattering techniques, (3) observations of helium migration in 316 stainless steel, (4) the effect of cyclotron-injected helium on the fatigue properties of 316 stainless steel, (5) an improved computer program for calculating energy deposition in matter by energetic heavy ions, (6) the development of a nickel beam intensity at the Van de Graaff which is one of the highest available anywhere, and (7) the use of a coincident alpha–alpha elastic scattering technique for nondestructive measurement of the content and concentration depth profile of helium in thin metal foils. (NTIS)

25198 (AD-758355) IRRADIATION EFFECTS ON REACTOR STRUCTURAL MATERIALS. Quarterly Progress Report, 1 November 1972–31 January 1973. Steele, L. E. (Naval Research Lab., Washington, D. C.). 15 Nov 1972. 46p. (NRL-MR-2560). NTIS.

The report includes: (1) post-irradiation notch ductility assessments of austenitic stainless steel weldments, (2) studies of fatigue resistance of neutron-irradiated cold-worked Type 304 stainless steel, (3) environmental exposure studies of candidate first-wall materials in the Princeton ST Tokamak, (4) observations of bubble growth in 216 stainless steel implanted with helium, and (5) helium–microstructure interaction in cyclotron-implanted, annealed, and cold-worked 316 stainless steel. (NTIS)

25199 (AERE-R-6849) INVESTIGATION OF THE CHANNELLING TECHNIQUE FOR ATOM LOCATION AND ITS APPLICATION TO HYPERFINE INTERACTION STUDIES ON IMPLANTED SOURCES. Alexander, R. B. (Atomic Energy Research Establishment, Harwell (England)). Jul 1971. 187p. Dep. NTIS (U. S. Sales Only) $11.50.

The channelling technique for atom location is described and applied to hyperfine interaction studies on impurity ions implanted into Fe. An experiment was carried out using a CuAu crystal in which the Au atoms (concentration ~2 at.%) occupy substitutional sites at random in the Cu lattice. With a beam of 1.2-MeV ^{4}He ions incident near the ⟨110⟩ axis, the angular dependence of the backscattered yield from the foreign Au atoms and the host Cu atoms was found to be identical. A computer simulation was undertaken of the axial channelling of ^{4}He ions in a Cu lattice. It was found that the flux distribution is not constant across the channel and is strongly peaked near the minimum of the transverse potential. A general study was made of the experimental techniques involved in atom location experiments, using Rutherford backscattering of ^{4}He and ^{14}N ions. Location measurements were made on Au and Sb implanted into Fe, for which hyperfine interaction measurements (using nuclear orientation) had already been performed. Both Au and Sb were found to be largely substitutional at implantation doses up to 10^{15} ions/cm^2. A combined nuclear orientation/location experiment was carried out on Br implanted into Fe at a dose of ~10^{14} ions/cm^2. In the nuclear orientation experiment, the average hyperfine field at ^{82}Br implanted into a Fe single crystal at this dose was measured as $\bar{H}_{eff}$ = 440 ± 40 kOe. From the location measurements it is concluded that no more than ~50% of the implanted Br atoms are substitutional. The implications of this for the hyperfine field measurement are discussed. (15 tables, 56 figures, 146 references) (auth)

25200 (CONF-730801-, pp 59-87) SURVEILLANCE TESTING AND PROPERTY EVALUATION OF BERYLLIUM. Beeston, J. M.; Martin, M. R.; Brinkman, C. R.; Korth, G. E.; Francis, W. C. (Aerojet Nuclear Co., Idaho Falls, ID). Aug 1973.

From symposium on materials performance in operating nuclear systems; Ames, Iowa, USA (28 Aug 1973).

The ductility of beryllium upon irradiation in test reactors reduces to almost nil at a relatively low fluence of 1 to 4 × 10^{21} n/cm^2 (E > 1 MeV), so that for about 90% of the life in test reactors beryllium performs its service function as a completely brittle member. This brittleness is due mostly to entrapped helium contained in a supersaturated solution or in small gas-trapping-centers wherein the helium atoms' influence on the strain field is given in terms of their atomic volume rather than a gas volume. This hypothesis is supported by growth data and transmission electron microscopy. The growth of 43 specimens was found to be represented by a least squares fit equation, $\Delta L/L\% = 0.1945(\phi t)^{0.93}$, indicating atomic behavior of the helium. Transmission electron microscopy did not resolve bubbles, although a low density light-center defect was sometimes associated with the black clumps characteristic of irradiation damage. Theories that have been used to define failure are the maximum stress, maximum shear stress, and the Nadai theory. The properties required for these definitions are the tensile, compression, and shear strengths. These strengths at a fluence of approximately 2 × 10^{22} n/cm^2 are respectively 42.5, 180.3, and 69.4 ksi. (8 tables, 9 figures, 26 references) (auth)

25201 (CONF-730801-, pp 108-132) EFFECTS OF IRRADIATION ON 6063 ALUMINUM STRUCTURAL COMPONENTS IN SAVANNAH RIVER REACTORS. Sturcken, E. F.; Krapp, C. W.; Alewine, G. B. (Savannah River Lab., Aiken, SC). Aug 1973.

From symposium on materials performance in operating nuclear systems; Ames, Iowa, USA (28 Aug 1973).

Mechanical and physical property studies were performed on 6063 aluminum structural components that were used as housings for fuel elements in the Savannah River reactors. The housings were irradiated to a fast fluence of 5.8 × 10^{21} n/cm^2 (E > 0.8 MeV) and to a thermal fluence of 9 × 10^{22} n/cm^2. Although there were losses in ductility, increases in notch sensitivity, and a small decrease in density (0.25%), the changes were considered insufficient to significantly affect the projected service life for the components. 4 tables, 11 figures, 24 references. (auth)

25202 (CONF-730801-, pp 133-152) CREEP PROPERTIES OF IRRADIATED ALUMINUM ALLOYS FROM THE HFIR SURVEILLANCE PROGRAM. King, R. T.; Farrell, K.; Richt, A. E. (Oak Ridge National Lab., TN). Aug 1973.

From symposium on materials performance in operating nuclear systems; Ames, Iowa, USA (28 Aug 1973).

Uniaxial creep specimens of the annealed 1100-0, annealed 6061-0, and precipitation-hardened 6061-T6 aluminum alloys were irradiated at temperatures between about 50 and 150°C to fast (E > 0.1 MeV) and thermal (E < 0.414 eV) neutron fluences in the ranges 0.5 to 7.3 × 10^{22} and 0.7 to 11.0 × 10^{22} neutrons/cm^2, respectively. Creep tests lasting up to about a thousand hours were performed at 50, 100, and 150°C. Significant irradiation-induced increases in creep strength were correlated qualitatively with postirradiation observations of dislocation structures and precipitates formed from transmutation-produced silicon. The greatest fractional loss of ductility occurred in 1100-0 aluminum, but the lowest postirradiation ductilities (~1%) occurred for the 6061-T6 alloy. The 6061-0 alloy had marginally better ductility than 1100-0 aluminum, and creep strength between those of the weaker 1100-0 and the stronger 6061-T6 alloys. While swelling due to void formation and silicon precipitation occurred in 1100-0 aluminum, no voids occurred in the 6061-0 or 6061-T6 alloys. (7 figures, 19 references) (auth)

25203 (NRL-Memo-2627) DISCUSSION OF THE POSSIBLE DOSE RATE EFFECT IN IRRADIATION OF PRESSURE VESSEL STEEL. Serpan, C. Z. Jr. (Naval Research Lab., Washington, D.C.). Aug 1973. Contract AT(49-5)-2110. 17p. Dep. NTIS $3.00.

A "dose-rate effect" for low alloy steel is based on the premise that radiation damage will be greater for a given fluence of neutrons when irradiation takes place at a low flux level over a long time than for irradiation for a short time at a high flux level. This is a very important consideration because these are the conditions under which accelerated irradiations are performed for short times to establish anticipated lifetime mechanical property changes in reactor vessel components that will be under irradiation for long times at low flux levels. The available theoretical and experimental evidence related to the dose-rate effect in low-alloy steel has been reviewed and is discussed. The conclusion reached is that trends in steel hardening and embrittlement by neutron irradiation are not noticeably influenced by the rate of irradiation when the rates (fluxes) are between 10^{10} and 10^{14} n/cm^2 · sec^{-1}, and the fluence received is <1 × 10^{20} n/cm^2 >1 MeV. Thus, although no evidence is available to validate a dose-rate effect in radiation damage of ferritic steels, this effect should be considered and constantly

sought in future results of experimental and operating-reactor irradiation data. (auth)

25204 (ORO-3612-10(Pt.2)) INVESTIGATION OF IRRADIATION STRENGTHENING OF BCC METALS AND SOLID SOLUTIONS. Progress Report, January–October 1973. (Maryland Univ., College Park). 1973. Contract AT(40-1)3612. 207p. Dep. NTIS $12.50.

A review is presented of the low-temperature deformation of bcc metals and their solid-solution alloys. Topics covered include: asymmetry of slip and yielding, dislocation configurations, core structure of screw dislocations, thermal activation analysis of dislocation dynamics, interstitial alloys, hydrogen alloys, substitutional alloys, radiation effects, and superconducting state. (67 figures, 150 references). (DLC)

25205 SOME PRELIMINARY STUDIES OF THE STRUCTURE OF ION-BOMBARDED THIN FILMS. Stroud, P. T.; Lindsay, H. M.; Perkins, J. G. (Atomic Weapons Research Establishment, Aldermaston, Eng.). Vacuum; 23: No. 4, 125-130(Apr 1973).

From institute of physics, atomic collisions group meeting; Aldermaston, England (12 Apr 1972).

Preliminary electron microscopic and diffraction studies of ion-implanted and recoil-atom implanted thin films are described. It is shown that oxygen-implanted aluminium films form complex cermets consisting of polycrystalline aluminium islands in an amorphous dielectric matrix. The dielectric consists of compounds made up of both substrate and film elements and the implanted oxygen. It has also been shown that oxygen-implanted titanium thin films form cermet structures of crystalline TiO in an amorphous dielectric probably containing TiO_2 and compounds of the silica substrate. The structure of silicon oxide films recoil implanted with silver from an argon-bombarded silver overlayer has been studied. It is shown that the recoil-implanted material forms discrete clusters within the substrate and that argon entering the silicon oxide forms bubbles. A recoil implantation coefficient of 1.1 silver atoms per incident argon ion has been measured. (auth)

25206 PRIMARY RECOIL ATOM SPECTRA AND DAMAGE CROSS-SECTION OF Fe_3Al. Smith, D. W.; Edwards, D. R.; Leighly, H. P. (Univ. of Missouri, Rolla). Radiat. Eff.; 18: No. 1-2, 27-33(Mar 1973).

The damage cross section and primary recoil atom spectra for Fe_3Al were determined by a computer program which used Evaluated Nuclear Data File (ENDF/B II) information. Energy-exchange kernels were developed which delineate the energy transfer probabilities between neutrons and Fe_3Al lattice atoms. The kernels combine all available information on the anisotropic elastic and inelastic scattering contained in the ENDF/B II data. The results of the investigation indicate that the primary recoil atom spectra of Fe_3Al is a sensitive function of the existing neutron environment and the damage cross section contains the effect of numerous contributions. (auth)

25207 VARIATION OF THE SPUTTERING YIELD OF GOLD WITH ION DOSE. Colligon, J. S.; Hicks, C. M.; Neokleous, A. P. (Univ. of Salford, Eng.). Radiat. Eff.; 18: No. 1-2, 119-126(Mar 1973).

From international conference on ion-surface interaction, sputtering, and related phenomena; Garching, Germany (Sep 1972).

In an earlier publication it was noted that the sputtering yields of gold varied considerably over an initial bombardment period during which approximately 6×10^{16} ions/cm^2 struck the target surface; above this dose, yields became constant and agreed reasonably well with other sources of data. Here, a modified version of the original apparatus is described, which allows up to one hundred experiments to be carried out in one evacuation under better uhv conditions. N_2^+ ions (0 to 600 eV) were used and, as the present technique allows measurement of total yields as low as 10^{12} atoms, a careful study of the sputtering yield–dose pattern was possible. Scanning electron micrographs of the gold surface at various stages of the bombardment indicate only slight surface roughening. A model based on the development of dislocation loops is proposed, which could explain the relatively long recovery time in the 600-eV yield that follows a short bombardment at a lower energy. (auth)

25208 IMPLANTATION OF ENVIRONMENTAL ATOMS INTO SOLIDS BY NEUTRON COLLISIONS IN REACTORS. Gaus, H.; Migge, H.; Mirus, K. D. (Hahn-Meitner-Institut fuer Kernforschung, Berlin). Radiat. Eff.; 18: No. 1-2, 79-86(Mar 1973).

During reactor irradiations of solids there is found a remarkable implantation of surrounding atoms due to fast-neutron collisions. This was verified in a thermal reactor for helium and deuterium and silver targets of different thickness. A dose of 4×10^{17} cm^{-2} (E > 0.1 MeV) on 600 Torr helium induces 2.8×10^{-5} at. % He up to a depth of about one micron. Calculations considering the implantation of knocked-on heliums with energies above some keV agree satisfactorily with the measurements. Calculations for a fast reactor yield a normalized helium profile very similar to that in a thermal reactor, but the concentrations are 2000 times larger for equal irradiation times and, therefore, may be important also in deeper regions. The amount of deuterium in silver is found to be about 10^3 times larger than that from corresponding calculations, indicating an additional chemical effect. The investigated implantation should be always considered, if the surface condition is important. (auth)

25209 METAL ION INJECTION INTO METALS. 1. Trapped Amounts, Sputtering Coefficients, and the Sputtering Model of Saturation. Smith, H. J. (Pretoria National Physical Research Lab.). Radiat. Eff.; 18: No. 1-2, 55-64(Mar 1973).

The loss of weight of target material as a function of dose of 39-keV ions injected at room temperature, as well as the amount of projectile material trapped, was measured for 13 metal ion–target combinations in simultaneous experiments. The results are correlated with the sputtering model of saturation, which is based on the assumption of no movement of trapped atoms. It is shown that the model is completely inadequate in describing the results, and that diffusion of trapped atoms in the target must be occurring. For some ions on Zn, Cd and Pb targets the trapped amount increases linearly with dose in spite of a high sputtering rate. (auth)

25210 METAL ION INJECTION INTO METALS. 2. Anomalous Diffusion in Cu and Zn at Room Temperature and 77 K. Smith, H. J. (Pretoria National Physical Research Lab.). Radiat. Eff.; 18: No. 1-2, 65-71(Mar 1973).

The existence of a very prominent diffusion effect during ion bombardment of Cu and Zn targets at room temperature and Zn targets at 77 K is demonstrated by measuring trapped amounts and sputtering coefficients at 77 K and comparison with the behavior at room temperature. Further information is obtained by investigating the distribution of trapped Ni projectile atoms in the substrates by argon ion sputtering and x-ray fluorescence analysis. The argon ion bombardment advances the Ni in the Zn at room temperature. The results can have a bearing on the interpretation of observations of noble gas ion bombardment as well as of the ranges of ions in metals. It also appears that the method of removing representative layers from a surface by noble gas ion sputtering is not generally valid. (auth)

25211 METAL ION INJECTION INTO METALS. 3. Irradiation System and Experimental Techniques. Smith, H. J. (Pretoria National Physical Research Lab.). Radiat. Eff.; 18: No. 1-2, 73-78(Mar 1973).

An irradiation system is described that allows homogeneous irradiation in an electromagnetic isotope separator of targets over a fixed area independent of the ion energy, while the ion current is measured continuously. The final aperture, defining the irradiation area, is situated directly in front of the target, electrically insulated from it, but at the same potential. Secondary electron suppression is achieved by a variable high positive potential on the target. This same potential also acts as a retarding potential, regulating the energy of the impinging ions. The use of atomic absorption and x-ray fluorescence to determine small amounts of trapped material is also described. The system and methods have facilitated an investigation of trapping and sputtering for metal ion–target combinations. The system is also convenient for producing isotopic targets for nuclear physics experiments. (auth)

25212 THERMAL ANNEALING OF LATENT DAMAGE TRAILS. Khan, H. A. (Univ. of Birmingham, Eng.). Radiat. Eff.; 18: No. 1-2, 51-54(Mar 1973).

The correction of thermally lowered track densities was approached from a new angle. The methods suggested either need the measurements of diameters of only circular etch pits or depend on the track densities alone, thus eliminating the tedious diametric measurements altogether. Experiments show that volume tracks lying wholly inside the sample during the annealing process are less stable than surface tracks with one of their ends intercepting the outer reference surface. Also, it is shown that the annealing property of genuine fission tracks can be advantageously utilized in the study of optically dirty samples. (auth)

25213 LOW-TEMPERATURE ELECTRON-IRRADIATION EFFECTS IN Zn. Myhra, S.; Gardiner, R. B. Radiat. Eff.; 18: No. 1-2, 39-46(Mar 1973).

The atomic displacement and recovery mechanisms of low-temperature electron-irradiated Zn were studied. Detailed annealing data are presented showing several distinct recovery stages below 70 K. One first-order stage at 9.5 K is shown to have an activation energy of 0.015 ± 0.003 eV, while there is evidence of slight dose dependence in the range 11 to 16 K. Several minor

stages are resolved above 16 K for high-dose irradiation. Threshold displacement data generally confirm earlier investigations. Previous results on several low-temperature-irradiated hcp metals are reviewed, and a number of common features are found. (auth)

25214 SPUTTERING YIELDS OF NIOBIUM BY DEUTERIUM IN THE keV RANGE. Eckstein, W.; Scherzer, B. M. U.; Verbeek, H. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). Radiat. Eff.; 18: No. 1-2, 135-137(Mar 1973).

From international conference on ion-surface interaction, sputtering, and related phenomena; Garching, Germany (Sep 1972).

The sputtering yields of ~600 Å niobium films bombarded by 3- to 8-keV D^+ ions have been measured. Rutherford backscattering of 150-keV H^+ ions was used as a probe to measure the decrease of film thickness due to sputtering. A sputtering yield of $S = 4 \times 10^{-3}$ atoms/ion was found, which is only weakly dependent on the energy. The result is about a factor of two lower than expected from extrapolating measurements made by Summers et al. (J. Appl. Phys., 42: 4774(1971)) at higher energies. The discrepancy may be due to differences in film structure, contamination by oxygen, and/or differences in the measuring methods, but cannot at the moment be clearly accounted for. (auth)

25215 LATTICE EFFECTS IN FAST ELECTRON ENERGY LOSSES BY PLASMON EXCITATION IN METALS. March, N. H.; Tosi, M. P. (Imperial Coll. of Science and Tech., London). Phil. Mag.; 28: No. 1, 91-102(Jul 1973).

It is well known that a fast electron moving through a metal can excite plasma oscillations and the theory has been fully worked out for a homogeneous electron gas. The object of this work is to take into account the periodic lattice in calculating the energy losses and angular distribution of fast particles, due to excitation of plasmon modes. The problem is formulated in general terms, but in order to expose the new features introduced by the lattice the lattice potential is treated as weak. The principal conclusions are: (i) the usual uniform electron gas result remains unchanged by the first-order term in the lattice potential unless the velocity vector V of the fast electron is along a lattice vector in either the direct or the reciprocal lattice. (ii) when V is along a lattice vector, the effects of the lattice can be expressed in terms of the Fourier components of the ground-state charge density, which are themselves accessible to experiment from X-ray intensities at the Bragg reflections. The general form of the angular distribution of the scattered electrons is modified in a way determined by the reciprocal lattice vectors orthogonal to the trajectory. The theory presented here may have direct relevance to energy losses in high-voltage electron microscopy. (auth)

25216 DENSIFICATION OF IRRADIATED METAL. France, D. W.; Ketcham, A. D. (to General Electric Co.). U. S. Patent 3,742,366. 26 Jun 1973. Filed date 18 Nov 1970. 6p.

A method of producing dense bodies of irradiated metal in various geometrical shapes to achieve near theoretical-density specimens of such metal is presented. These specimens are excellent radiation sources of high specific activity for medical-therapeutic and industrial radiographic applications. The process starts with a target metal which is encapsulated in a metallic jacket and irradiated with a flux sufficient to convert a substantial portion of the target metal to a radioisotope. The irradiated metal is removed from the capsule and a given amount of the irradiated metal sufficient to give a known energy output is segregated and either (a) arc melted or (b) inductively cast to achieve a desired configuration as a radiation source. The process gives irradiated metal with a very small focal point and a very high density. (Official Gazette)

25217 BLISTERING OF MOLYBDENUM UNDER HELIUM ION BOMBARDMENT. Erents, S. K.; McCracken, G. M. (Culham Lab., Abingdon, Eng.). Radiat. Eff.; 18: No. 3-4, 191-198(1973).

Polished molybdenum targets were bombarded with helium ions of energy from 7 to 80 keV in ultrahigh vacuum. During bombardment, the release of gas was continuously monitored, and after bombardment the targets were examined in a scanning electron microscope. Blister formation was observed to occur after a critical dose of $\sim 5 \times 10^{17}$ ions/cm^2, and the appearance of blisters coincides with gas release from the surface. The average size of the blisters increases with energy but not with ion dose. In addition to room-temperature observations, blisters were also examined following high-temperature bombardment of molybdenum, and room-temperature bombardments of W, Pt, Ni, Cu, and Zr targets. (auth)

25218 OBSERVATION OF CLUSTERS IN A SPUTTERING ION SOURCE. Herzog, R. F. K.; Poschenrieder, W. P.; Satkiewicz, F. G. (GCA Corp., Bedford, MA). Radiat. Eff.; 18: No. 3-4, 199-205(1973).

The dependence of cluster ion intensities on the bombarding gases He^+, Ar^+, and Xe^+ (energies 4 to 12 keV, current densities 100 mA/cm^2) is reported. Frequently, the observed structures in the relative cluster intensities were quite puzzling, e.g., for Al and Si. Attempts to correlate these structures to crystal configurations failed, nor did any pattern develop from simple valency considerations alone. Initial ion energy distribution measurements from 0 to 1200 eV showed significant differences for atomic ions and cluster ions. This effect is used to reduce interference problems caused by cluster ion peaks in SIMS (secondary-ion mass spectrometry) applied to trace analysis of solids. The results are discussed and compared with those of other investigators, also including cluster formation by vaporization and sparking. Extending known theoretical considerations may possibly afford a general understanding of the intensity structure. The formation and ejection mechanisms of clusters, however, remain unknown. Thermal effects to explain the latter are definitely discounted by the magnitude of the observed initial cluster energy (>10 eV). Also discussed are two phenomena which demonstrate the presence of the bombarding gas in the surface. (auth)

25219 DEPTH ANALYSIS OF CLEAVED MICA SURFACES MONITORED BY AUGER SPECTROSCOPY. Staib, P. (Max-Planck Institut fuer Plasmaphysik, Garching, Ger.). Radiat. Eff.; 19: No. 3-4, 217-219(1973).

Vacuum cleaved mica surfaces (muscovite) are etched by a 500-eV argon ion beam. The surface composition of the cleaved surface is known from the succession of atomic layers in the crystal. The surface structure and its chemical composition are analyzed by LEED and Auger electron spectroscopy. It is shown that the bombardment quickly destroys the crystal structure, making an accurate depth analysis of the sample impossible. (auth)

25220 OBSERVATION OF DAMAGE IN HELIUM-ION-IRRADIATED GOLD FILMS USING TRANSMISSION ELECTRON MICROSCOPY. Brown, R. D.; Rao, P.; Ho, P. S. (Cornell Univ., Ithaca, NY). Radiat. Eff.; 19: No. 3-4, 149-155(1973).

Transmission electron microscopy was applied to the study of damage in gold irradiated with 35-keV He^+ ions to fluences of 10^{14} to 10^{16} ions/cm^2. Damage in as-irradiated specimens consisted of dislocation loops showing double arc contrast which loop analysis revealed to be about 30 to 50% interstitial in nature. Depth distributions of the defect clusters were determined using stereo microscopy. Annealing at increasing temperature resulted in a decrease in loop density together with an increase in loop diameter. Voids formed at annealing temperatures between 0.5 T_m and 0.58 T_m on and in the vicinity of dislocation tangles formed from the loops, and were identified from a through-focus sequence of micrographs and by kinematical imaging. Increasing void diameter with decreasing void density on annealing at higher temperature indicated that the voids were gas filled and were growing via migration and coalescence. (auth)

25221 GROWTH KINETICS AND ORIENTATION DEPENDENCE OF DISLOCATION LOOPS IN ELECTRON-IRRADIATED ALUMINIUM. Chen. J. H.; Rao, P.; Ho, P. S. (Cornell Univ., Ithaca, NY). Radiat. Eff.; 18: No. 3-4, 157-166(1973).

Quantitative studies show that the defect cluster production and growth rates, as a result of 200-kV electron irradiation of aluminum, are strongly influenced among several factors by crystal thickness, crystal orientation, impurity content, and room-temperature vacancy mobility. Strong evidence of vacancy mobility is obtained from the very low point defect retention ratio observed experimentally. Considerable insight into the defect production and retention process can be obtained by an analysis of the dislocation loop growth rate data according to models based on chemical reaction rate theory. As a result, the migration energy for free interstitials in aluminum is estimated to be 0.06 eV, while with strong interstitial–impurity binding the migration energy is 0.4 eV. Analysis of the electron irradiation data in aluminum suggests that interstitial–impurity binding controls defect cluster nucleation. Further evidence for this is obtained by comparing the surface denuded zone width calculated by assuming interstitial–impurity binding with that observed experimentally. Dislocation loop growth rates analyzed according to the kinetic models show that the surfaces influence the initial loop growth while bulk behavior is approached at a later state. There is considerable orientation dependence of damage observed between the ⟨100⟩ and ⟨111⟩ orientations. Maximum damage rates are observed at exact low index orientations with sharp drop offs by a factor of ~3 when the crystal is tilted 3 to 5° away from these orientations. (auth)

25222 ANGULAR DEPENDENCE OF CLUSTERS SPUTTERED FROM A TUNGSTEN SINGLE-CRYSTAL SURFACE. Staudenmaier, G. (Univ., Munich). Radiat. Eff.; 18: No. 3-4, 181-184 (1973).

The anisotropy of positively charged clusters sputtered with

150-keV Ar^+ ions from a tungsten single crystal was investigated with a mass and energy spectrometer. Not only the monomer W^+ but also the clusters W_2^+, W_3^+, and W_4^+ (so far investigated) show maxima of emission along close packed directions. The maximum cluster yield along a ⟨111⟩ direction normalized to the yield along a random direction increases with increasing cluster size and cluster energy, although the absolute cluster yield decreases. An interpretation of the experimental results on the basis of a simple statistical model of cluster formation kinetics is presented which explains the yield profiles of the anisotropic contribution fairly well. (auth)

25223 BLISTERING OF POLYCRYSTALLINE AND MONOCRYSTALLINE NIOBIUM. Kaminsky, M.; Das, S. K. (Argonne National Lab., IL). Radiat. Eff.; 18: No. 3-4, 245-250(1973).

Radiation blistering of niobium surfaces was investigated for normally incident He^+ and D^+ projectiles. For the He^+, the bombarding energies were 0.5 and 1.5 MeV, the targets were both monocrystalline and polycrystalline niobium at room temperature and at 900°C, and the total dose was from 0.01 to 1.0 C/cm². For cold-worked samples at room temperature, 0.5-MeV He^+ ions produced large blisters (up to 500 μm in diameter), many of which were ruptured; 1.5-MeV He^+ ion implantation produced one big blister covering most of the irradiated area. For the D^+ ion implantation, the bombarding energies were 0.250 and 0.5 MeV and the targets were all polycrystalline. Implanting 0.250-MeV D^+ ions in annealed polycrystalline Nb at 700°C produced small blisters for doses ranging from 1.6 to 3.0 C/cm². Preliminary results on the skin thicknesses of ruptured blisters indicate a close relationship between the thickness and both the projected range of the ions and the peak in the defect distributions. (auth)

25224 INVESTIGATION OF TRAPPING LEVELS IN HEAVY ION IMPLANTED CADMIUM TELLURIDE. Gettings, M.; Stephens, K. G. (Surrey Univ., Guildford, Eng.). Radiat. Eff.; 18: No. 3-4, 275-277(1973).

Semi-insulating CdTe was implanted with argon, indium, tellurium, and bismuth ions at energies of 50 or 100 keV. Carrier trapping levels were detected at approximately 0.1, 0.3, 0.4, and 0.55 eV, using the thermally stimulated current technique. Not all of these levels were produced by each ion for each dose used. After annealing at 300°C, no levels were detected. (auth)

25225 SIMULATING VOID FORMATION IN FAST REACTOR STEELS. Hudson, J. A.; Mazey, D. J.; Nelson, R. S. (Atomic Energy Research Establishment, Harwell, Eng.). Kerntechnik; 15: No. 7, 312-313(1973).

The swelling due to void formation and growth, which occurs in certain structural components of fast-reactor cores after prolonged irradiation at elevated temperatures, can be simulated by high-energy charged-particle irradiations. In the Harwell Variable Energy Cyclotron specimens may be bombarded with 20-MeV C^{2+} or 48-MeV Ni^{6+} ions. Such bombardments produce radiation damage at about 1,000 times the rate due to neutrons in a fast reactor. Since this damage is created several micrometers below the bombarded surface the technique can be used as a quantitative simulation of bulk material undergoing neutron bombardment. Results of investigations of irradiation-induced swelling are presented. The dislocation structures found in the bombardment metals are also briefly described and the results discussed with respect to recent theories of void growth in metals. (GE)

25226 MOESSBAUER STUDIES OF LOW-TEMPERATURE RADIATION DAMAGE IN α-IRON. Vogl, G.; Schaefer, A.; Mansel, W.; Prechtel, J.; Vogl, W. (Technische Univ., Munich). Phys. Status Solidi (b); 59: No. 1, 107-120(1 Sep 1973).

The Moessbauer effect was used to study radiation damage in α-iron, doped with 0.6 at.% Os and 4 at.% Pt. The samples were irradiated in a nuclear reactor at 4.6°K. The Moessbauer nuclei of ^{193}Ir and ^{197}Au were produced by capture of thermal neutrons in ^{192}Os or ^{196}Pt, a process which simultaneously could lead to radiation damage. Compared with annealed samples, the average magnetic field was reduced after the irradiation by about 2% and the line width was increased by approximately 30%. Isochronal annealing processes were studied. The annealing of the irradiation effects took place primarily between 90 and 140°K with activation energies in the range between 0.30 and 0.40 eV. These effects are interpreted as mainly due to a vacancy as nearest or next nearest neighbor of the displaced Moessbauer atom combined with an interstitial several lattice sites away from the vacancy. The Moessbauer atom does not come to rest as an interstitial atom. These results are in good agreement with results from computer experiments of Vineyard's group. (5 figures, 36 references). (auth)

25227 DEFECT ANNEALING IN NEUTRON-IRRADIATED NIOBIUM DOPED WITH OXYGEN. Naskidashvili, I. A.; Martkoplishvili, G. S.; Viting, L.; Maisuradze, N. A. (Inst. of Physics, Tbilisi, USSR). Soobshch. Akad. Nauk Gruz. SSR; 71: No. 2, 329-332(Aug 1973). (In Russian).

The interaction between radiation defects in niobium and interstitial impurity oxygen atoms was investigated. It was established that vacancy–oxygen complexes are formed in stage III. (auth)

25228 ADIABATIC INVARIANCE IN CHANNELING EXPERIMENTS. Kumakhov, M. A. (Moscow State Univ.). Phys. Lett., 45A: No. 2, 121-133(10 Sep 1973).

A relation between energy losses and electron density is obtained for the case of planar channeling. It is theoretically shown that, in a number of cases, the energy losses are related by a linear dependence to the oscillation frequency of channeled particles. (auth)

25229 INVESTIGATION OF SELF-IRRADIATION DAMAGE IN PLUTONIUM BY POSITRONIUM ANNIHILATION. Gustafson, D. R.; Barnes, G. T. (Wayne State Univ., Detroit). J. Nucl. Mater.; 48: No. 1, 79-85(Aug 1973).

The angular correlation of positron annihilation radiation from the ε phase of plutonium metal at 535°C indicates that approximately 1% of the positrons are annihilating directly from the singlet state of positronium. Since positronium cannot form in the bulk metal, it is hypothesized that the positronium is forming in cavities in the metal which are presumably caused by self-irradiation damage. Analysis of the angular correlation yields an estimate of the average cavity size of 17 Å. The cavities created in the ε phase are observed to persist upon cooling to the δ′ and β phases. The question of whether the cavities are voids, voids stabilized by the presence of helium gas, or helium gas bubbles was not resolved. (2 tables, 2 figures, 14 references) (auth)

25230 ANOMALOUS TRANSMISSION OF SWIFT ELECTRONS IN THICK CRYSTALS. Bobudaev, A. Ya.; Kaplin, V. V.; Vorobiev, S. A. (Tomsk Polytechnical Inst., USSR). Phys. Lett., 45A: No. 1, 71-72(27 Aug 1973).

A large penetration of swift electrons along the lattice crystallographic axes was observed. The center transmission peak of 2-MeV electrons along the ⟨100⟩ axis in 110-μm NaCl shows a narrow dip of width at half-minimum (0.2 ± 0.05). The half-width of the maximum base (0.7 ± 0.1) is in agreement with the classical mechanical calculation. (auth)

25231 HIGH-TEMPERATURE DEFORMATION AND FRACTURE OF AN IRRADIATED AUSTENITIC STAINLESS STEEL WITH ADDITIONS OF TITANIUM AND BORON. Hellstrand, E.; Lagneborg, R.; Linghagen, P.; Westin, R.; Oestberg, G. (Aktiebolaget Atomenergi, Studsvik, Sweden). J. Nucl. Mater.; 48: No. 1, 1-14 (Aug 1973).

A chromium–nickel–molybdenum stainless steel with titanium and boron additions, solution-treated or solution-treated, cold-worked and recovery-annealed, was studied before and after irradiation in a thermal materials-testing reactor. Irradiations were performed at 700°C to almost complete boron-10 burnup. The post-irradiation creep properties were compared with the creep properties of the steel as delivered and after a parallel annealing at 700°C. Broadly speaking, the creep strength of the solution-treated steels was not altered as a result of irradiation but was decreased by annealing at 700°C. The opposite was true for the cold-worked recovery-annealed material. These effects are due to different modes of TiC precipitation during or before testing and to the degree of recovery after cold work. Irradiation reduced the ductility to a varying degree, depending on the material condition. The smallest change was observed on 1100°C-annealed steel after cold work and recovery-anneal at 850°C. That condition also had the smallest grain size. The effect of irradiation on the ductility may be explained in terms of the diffusion of boron to the grain boundaries during irradiation at 700°C, and the influence of the resulting helium-rich zones at grain boundaries. (15 figures, 6 tables, 23 references) (auth)

25232 RESISTANCE TO VOID FORMATION OF Cu–Ni ALLOYS. Mazey, D. J. (Atomic Energy Research Establishment, Harwell, Eng.); Menzinger, F. J. Nucl. Mater.; 48: No. 1, 15-20(Aug 1973).

Cu–Ni alloys were found by Brimhall and Kissinger to be void-resistant in a low-dose neutron-irradiation experiment. This fact was investigated at much higher damage doses by means of irradiations at various temperatures between 300 and 600°C with Ni^+, Cu^+, C^+ at 0.1 MeV, or Ni^{6+} at 46.5 MeV. Only the 2% Cu and 2% Ni alloys showed voidage while those containing 20, 50, 80% Ni were found to be completely free from voids at atom displacement levels well in excess of 30 dpa. It is proposed that fine-scale clusters having a different composition from the solid-solution matrix may be acting as traps for displaced interstitials and vacancies, so inhibiting vacancy agglomeration into voids. (auth)

25233 ROLE OF IMPURITIES IN FORMATION OF DAMAGE IN QUENCHED AND NEUTRON-IRRADIATED MATERIALS. Westmacott, K. H. (Michelson Lab., China Lake, CA). pp 197-200 of III Interamerican Conference on Materials Technology. Buenos Aires; Centro Regional de Ayuda Tecnica (1972).

From 3rd Inter-American conference on materials technology; Rio de Janeiro, Brazil (14 Aug 1972). See CONF-720832-.

Transmission electron microscopy (TEM) studies of the structure of quenched or neutron-irradiated metals are continuing in attempts to understand the basic mechanisms of defect cluster nucleation and growth. Recent results on copper which demonstrate the importance of trace amounts of certain impurities on the type and stability of the defect structure which is developed are reviewed and a discussion of a recent nucleation model given. (20 references) (auth)

25234 RADIATION-INDUCED VOID FORMATION IN REACTOR CORE MATERIALS. Grinberg, M. (Instituto de Engenharia Nuclear, Guanabara, Brazil); Davidson, D. L. pp 229-235 of III Interamerican Conference on Materials Technology. Buenos Aires; Centro Regional de Ayuda Tecnica (1972). (In Spanish).

From 3rd Inter-American conference on materials technology; Rio de Janeiro, Brazil (14 Aug 1972). See CONF-720832-.

The formation of voids in core materials subjected to fast neutron fluxes is a phenomenon under intense study at the present time because of its consequence to the development of fast breeder reactors. This review defines the problem, examines its consequences, and briefly summarizes some of the experimental and theoretical work being done on Type 304 stainless steel to explain the mechanisms of void formation and growth. (5 figures, 10 references) (auth)

25235 CALORIMETRY: A LOW-TEMPERATURE EXPERIMENTAL TECHNIQUE. Bochirol, L.; Bonjour, E. (CEN, Grenoble, France). Rev. Fr. Elec.; 46: No. 241, 8-15(1973). (In French).

The low temperature range is defined as the 0 to 100°K temperature range. A special attention is given to calorimetry experiments in low-temperature solid physics, at the CEN.G (study of defects after neutron irradiation, moderator materials or fuel element materials, stored energy and specific heat measurements). Various important industrial applications are developing from the use of superconductors in low-temperature techniques. (auth)

Other Materials

Refer also to abstracts 24254, 24307, 24316, 24984, 25006, 25011, 25208, 25212, 25644, 26779, 26857, and 26909.

25236 (BNWL-1687) GRAPHITE FOR HELIUM-COOLED REACTORS. A Review. Tingey, G. L.; Morgan, W. C. (Battelle Pacific Northwest Labs., Richland, Wash.). Sep 1972. Contract AT(45-1)-1830. 81p. Dep. NTIS $6.25.

This review encompasses information on the manufacture of nuclear graphites, including the improved isotropic grades, the physical, chemical, and morphological differences among these materials, the theory of radiation-induced changes as influenced by morphology, and available data on radiation-induced changes in dimensions, physical properties, and chemical reactivity. The review also includes information on neutron dosimetry, carbon displacement cross sections, and the general problem of transposing data from one reactor to another. In lesser detail, information on other materials, such as boron carbide, nongraphitized carbons, and pyrolytic carbon coatings, is reviewed with respect to possible use and performance in a HTGR. (12 figures, 3 tables, 215 references) (auth)

25237 (EUR-5018) PREPARATION OF GRAPHITE IMPREGNATED WITH GLASSES OR MOLTEN CERAMICS AT HIGH TEMPERATURE. Burg, H.; Parnisari, E.; Van Rutten, F. (European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center). Jun 1973. 29p. (In French). Dep. NTIS (U.S. Sales Only) $3.50. EUR FB 40,-.

A study was made to find a method of impregnating graphite using molten ceramics or glasses. The different ceramics and glasses selected should give an impregnated impervious graphite, having acceptable nuclear properties. Experimental tests were done on the behavior of these materials during annealings and thermal cycling up to 1000°C. (auth)

25238 (LA-5329) MEASUREMENT OF OXYGEN-TO-METAL ATOM RATIOS IN URANIUM AND PLUTONIUM OXIDES. Dahlby, J. W.; Marshall, T. K.; Waterbury, G. R.; Swanson, G. C. (Los Alamos Scientific Lab., N. Mex.). Aug 1973. Contract W-7405-eng-36. 10p. Dep. NTIS $4.00.

Optimum conditions to produce stoichiometric dioxides from high-purity uranium and plutonium metals were determined. Results led to modifications to improve two thermogravimetric methods of analysis which are described. Problems in O/M measurement caused by the lack of a standard oxide reference material and inhomogeneity of the sample and the difficulties in interpretation of results obtained by various methods are discussed. (36 references) (auth)

25239 (N-73-13654) DEVELOPMENT AND CHARACTERIZATION OF LUBRICANTS FOR USE NEAR NUCLEAR REACTORS IN SPACE VEHICLES. Final Report, 15 May 1971–15 May 1972. Robinson, G. L.; Akawie, R. I.; Gardos, M. N.; Krening, K. C. (Hughes Aircraft Co., Culver City, Calif.). Sep 1972. Contract NAS8-25318. 133p. (NASA-CR-123966). NTIS.

Synthetic approaches resulted in nonpolymeric, large-molecular-weight materials, all based on some combination of siloxane and aromatic groups. Evaluation of these materials indicated that certain tetramethyl and hexamethyl disiloxanes containing phenyl thiophenyl substituents are extremely promising with respect to radiation stability, wide temperature range, good lubricity, oxidation resistance, and additive acceptance. The synthesis of fluids is discussed, and the equipment and methods used in evaluation are described, some of which were designed to evaluate micro-quantities of the synthesized lubricants. (auth)

25240 MAGNETIC SUSCEPTIBILITY OF UP–ThP SOLID SOLUTIONS. Adachi, H.; Imoto, S.; Kuki, T. (Osaka Univ.). Phys. Lett., 44A: No. 7, 491-492(13 Aug 1973).

The magnetic susceptibilities of UP–ThP solid solutions were measured from 4.2°K to 300°K. The lower temperature transition due to the increase in ordered moment found in UP persisted in solid solutions up to 40% ThP. (auth)

25241 DIAMAGNETISM OF GRAPHITE. Sharma, M. P.; Johnson, L. G.; McClure, J. W. (Univ. of Oregon, Eugene). Phys. Lett., 44A: No. 7, 445-446(13 Aug 1973).

The temperature-dependent diamagnetism of graphite is accounted for using band parameters agreeing with magnetoflection, optical, and de Haas-van Alphen results. The agreement requires inclusion of the effects of trigonal warping and addition of a small paramagnetic constant. (auth)

25242 ANALYSIS OF THE BACKSCATTERING SPECTRA OF COMPOUND SEMICONDUCTORS. Grob, J. J.; Ghitescu, A.; Siffert, P. (CNRS, Strasbourg). Radiat. Eff.; 18: No. 1-2, 139-140(Mar 1973).

It is shown that previous analyses of the spectra obtained by the backscattering technique on compound semiconductor crystalline targets are incorrect, leading to errors in the determination of the random level of radiation damage. (auth)

25243 TOPOGRAPHY OF SPUTTERED SEMICONDUCTORS. Wilson, I. H. (Univ. of Surry, Guildford, Eng.). Radiat. Eff.; 18: No. 1-2, 95-103(Mar 1973).

From international conference on ion-surface interaction, sputtering, and related phenomena; Garching, Germany (Sep 1972).

The surfaces of semiconductor single crystals were observed using a scanning electron microscope after bombardment at normal incidence at room temperature with doses between 0.5×10^{18} and 3×10^{18} of 40-keV argon ions/cm^2. The usual topography of the sputtered surface and the perturbing effects of dirt and contamination are reported, and observations of the variation of topography with dose are reported for GaAs. An explanation for the features observed is discussed with particular reference to current models of cone formation and secondary processes such as flux enhancement at the foot of steep slopes. The behavior of Si, Ge, GaAs, and InP was consistent with an amorphous surface. In the case of CdTe, CdS, and GaP it appeared that the crystal structure was retained resulting in a topography of the sputtered surface that is sensitive to orientation. InSb appears to undergo a chemical change during ion bombardment. (auth)

25244 CADMIUM-IMPLANTED GALLIUM ARSENIDE. A Study of Residual Bombardment Disorder and Atom Location. Ilic, G.; Ewan, G. T.; Whitton, J. L. (Queen's Univ., Kingston, Ont.). Radiat. Eff.; 18: No. 1-2, 47-49(Mar 1973).

The influence of specimen temperature on residual bombardment-induced damage and atom location was studied for 40-keV Cd implanted into {111} GaAs at doses from 1 to 4×10^{14} ions/cm^2. Results show that implantation into specimens at 150°C to 350°C is preferable to room-temperature implants followed by a separate annealing stage. (auth)

25245 SILICON AMORPHIZATION DURING DIFFERENT MASS ION IMPLANTATION. Baranova, E. C.; Gusev, V. H.; Martynenko, Yu. V.; Starinin, C. V.; Haibullin, I. B. (Inst. of Atomic Energy, Moscow). Radiat. Eff.; 18: No. 1-2, 21-26(Mar 1973).

Amorphization of silicon single crystals during different-mass 80-keV ion bombardment (B^+, C^+, Ne^+, Ar^+, Sb^+) was studied by

means of three independent techniques, (a) ir absorption at 1.8-μ wavelength (divacancy absorption), (b) ir reflection near a fundamental absorption edge, and (c) electron microscopy and fast-electron diffraction. Irradiation was carried out at room temperature. From the analysis of data obtained it can be concluded that two types of disordered regions arise during ion bombardment: (a) amorphous regions (AR) and (b) disordered, but still possessing crystalline structure regions, which are called the crystalline disordered regions (CDR). In CDR the defect concentration is so high that divacancies do not appear. The defect concentration in CDR gradually increases with the increasing of irradiation dose. When the defect concentration achieves some critical value, CDR transforms sharply to an amorphous state. Such amorphization mechanism prevails for light ions. For heavy ions (Sb^+) amorphization arises mainly from a one-step AR formation. The proposed model of amorphization gives the qualitative explanation of dose dependences of refractive index for different ions. (auth)

25246 APPLICATION OF A STOPPING POWER FORMULA TO CHANNELED IONS. Brice, D. K. (Sandia Labs., Albuquerque, NM). Radiat. Eff.; 18: No. 1-2, 13-16(Mar 1973).

A formula based on a modification and extension of the Firsov theory for the electronic stopping cross section has been fit to experimental data for helium ions incident on silicon. This formula was previously found to give a good fit to all available data for gaseous targets. It is demonstrated that it also applies for ions in solids for both random and channeled incidence. The parameters of the formula are given for helium incident along random directions and along ⟨111⟩, ⟨110⟩, and {111}. The results suggest that proper channeled particles contribute significantly to the ⟨110⟩ energy loss spectra at energies below 400 keV. (auth)

25247 IONIZATION EFFECTS IN SELF-INTERSTITIAL MIGRATION AND IMPLANT DAMAGE ANNEALING IN SILICON. Norris, C. B.; Brower, K. L.; Vook, F. L. (Sandia Labs., Albuquerque, NM). Radiat. Eff.; 18: No. 1-2, 1-8(Mar 1973).

An attempt was made to induce the charge-state-dependent migration of the silicon self-interstitials (Si_i) presumably produced in a shallow ion-implant-damaged Si layer (160-keV O^+, $1 \times 10^{13}/cm^2$, 300 K) by subsequently applying intense ionization from more deeply penetrating but nondamaging electron irradiations (5 to 20 keV e^-, $7.5 \times 10^{18}/cm^2$, 260 to 280 K). The samples used had been bulk doped with substitutional aluminum (Al_s). EPR of the aluminum interstitials (Al_i^{++}), believed to be produced by replacement of Al_s by Si_i, was monitored to detect Si_i migration into the bulk of the sample. No evidence was found that intense ionization following implantation causes significant enhancement of Si_i migration. This result suggests a conflict between the concept of isolated Si_i thermally stable at 300 K and the hypothesis of an athermal, charge-state-dependent mechanism for Si_i migration. A search was made for ionization-stimulated annealing of the vacancy-associated lattice damage resulting from O^+ implantation. EPR measurements show that intense ionization at 300 K causes negligible annealing of this damage, despite the fact that significant thermal annealing does occur slightly above 300 K. The results suggest that ionization is not the only factor involved in implant damage annealing or in the puzzling migration of the Si_i. (auth)

25248 WORK OF FRACTURE AND FRACTURE TOUGHNESS OF GRAPHITE. Vitovec, F. H. (Univ. of Alberta, Edmonton). J. Test. Eval.; 1: No. 3, 250-254(May 1973).

Compact tension tests and notched bend tests, according to Tattersall and Tappin, were performed on nuclear graphite in different orientations relative to the extrusion direction. The extension of slow propagating cracks was measured. The critical crack extension compares with the dimensions of defects in the graphite such as shrinkage cracks, pores, and crack-like pores, which are caused by the extrusion process. Taking these cracks into account results in comparable fracture toughness values regardless of whether they are determined by a load criterion or from the work of fracture. (auth)

25249 GRAPHITE. Peterson, G. R. (to United States Atomic Energy Commission). Australian Patent 431,341. 18 Dec 1972. Priority date 15 Apr 1968, United States of America (USA).

The invention relates to a process for preparing high-density isotropic graphite that is 100% graphite, the product thereof being especially suitable for nuclear applications. Graphite flour (no greater than 5μ in size) is wet blended with pitch and the admixture is formed into an isotropic graphite structure having a density within the range of 1.70 to 1.95 g/cm^3. The isotropic graphite structure is heated in a confining die, which maintains the original density, at an elevated temperature to carbonize the pitch and remove any volatile materials, and thereafter the resulting structure is subjected to a series of impregnations (with pitch) and heating cycles to produce a fully graphitized structure. (AEC)

25250 RESISTANCE OF SOME INORGANIC ION EXCHANGERS AGAINST GAMMA RADIATION. Gill, J. S.; Tandon, S. N. (Univ. of Roorkee, India). Radiochem. Radioanal. Lett.; 14: No. 5-6, 379-383(5 Sep 1973).

The effect of γ radiation on the solubility, ion-exchange capacity, and distribution ratio of some inorganic ion exchangers was investigated. The results were compared with ion-exchange resins. The inorganic ion exchanger is fairly stable to a γ dose of 10^9 rads while the organic resins start deteriorating. (auth)

25251 EFFECTS OF VARIOUS MANUFACTURING CONDITIONS ON DARKENING AND FADING OF PHOTOCHROMIC GLASSES. Maki, T.; Tashiro, M. (Kyoto Univ., Uji, Japan). Bull. Inst. Chem. Res., Kyoto Univ.; 50: No. 6, 621-633(Nov 1972).

Effects of melting time, heat-treatment time, and γ irradiation before heat treatment on darkening and fading of a photochromic glass were investigated. The degree of darkening was determined principally by the amount of AgCl crystal particles precipitated in the glass and the absorption coefficient of the particles. The latter showed the maximum when the particle diameter was about 400 A. The fading rate was high for the specimens that exhibited the strong absorbance after the completion of uv illumination. (auth)

25252 EFFECT OF DEFORMATION RATE AND IRRADIATION ON THE STRENGTH OF CAPRONE. Troitskii, O. A. (Inst. of Physical Chemistry, Moscow). Fiz.-Khim. Mekh. Mater.; 9: No. 3, 45-48(1973). (In Russian).

The rate dependence of the strength and the load reduction during cessation of the stretching of caprone, exposed to electron irradiation, were studied. It was shown that at outputs of 0.025 Mrad/sec and a single absorbed radiation dose applied during deformation, the mechanical properties are affected more strongly than with a preliminary dose. The breaking stress of the oriented caprone is decreased as a result of irradiation in two doses. The different stress state of the polymer reflects the degree of its radiation damage. The decrease of the strength noted during irradiation and deformation of the caprone was explained by the appearance of polyamide radicals. (tr-auth)

25253 DAMAGE INDUCED IN GaP SINGLE CRYSTALS BY Te ION BOMBARDMENT. Naguib, H. M.; Grant, W. A.; Carter, G. (Univ. of Salford, Eng.). Radiat. Eff.; 18: No. 3-4, 279-281 (1973).

A preliminary report is presented on an observation made by the reflection electron-diffraction technique (RED) on the damage produced in GaP single crystals implanted with 40-keV Te ions at doses between 1×10^{13} and 5×10^{15} ions/cm^2. It is concluded that individual damage regions in GaP induced by heavy ion bombardment remain crystalline at low and intermediate doses ($<1 \times 10^{14}$ ions/cm^2). In addition, the annealing behavior of the damage formed at high doses indicates that the implanted region is still in a microcrystalline state. (UK)

25254 THERMAL AND ELECTRICAL CONDUCTIVITY OF GRAPHITE OBTAINED BY THERMOMECHANICAL PROCESSING IN THE RANGE 80 TO 2500°K. Dymov, B. K.; Lutkov, A. I.; Volga, V. I. Heat Transfer—Sov. Res.; 5: No. 3, 149-151(1973).

Results of research on changes in thermal and electric conductivity of graphites produced by thermomechanical treatments at 80 to 2500°K are presented. Graphites having bulk weights from 2 to 2.2 g/cm^3 were used in the experiments. Part of the graphite specimens contained additions of B while others contained difficultly fusible metals and silicon. Results are presented graphically and discussed. (JRD)

25255 STUDY OF V_k CENTERS IN CsI CRYSTAL. Sidler, T.; Pellaux, J. P.; Nouailhat, A.; Aegerter, M. A. (Univ., Zurich). Solid State Commun.; 13: No. 4, 479-482(15 Aug 1973).

V_k centers were observed in CsI doped with Na^+ and Tl^+ after x-ray irradiation at liquid-He temperature using optical (absorption spectra) and EPR techniques. It is shown that they are oriented along [100] directions. By studying thermoluminescence, two types of thermal migration were found, one due to linear displacement of the centers along the cubic axis and the other due to 90° rotations. They correspond to two glow peaks at 60 and 90°K, respectively. (auth)

25256 TEMPERATURE DEPENDENCE OF THE DYNAMIC INTERSTITIAL INTERACTIONS IN POTASSIUM BROMIDE. Saidoh, M.; Hoshi, J.; Itoh, N. (Nagoya Univ., Japan). Solid State Commun.; 13: No. 3, 431-433(1 Aug 1973).

Formation of the H and H_A centers in Na^+-doped KBr within the time constant of the thermal annihilation of the H center is measured between 80 and 200°K and it is shown that the volume of the interaction of the radiation-induced replacement sequence of an interstitial halogen with a Na^+ impurity increases with an activation energy of (0.025 ± 0.005) eV as the temperature rises. (auth)

25257 NEUTRAL VACANCY IN DIAMOND. Clark, C. D.; Walker, J. (Univ. of Reading, Eng.). Proc. Roy. Soc. (London), Ser. A; 334: No. 1597, 241-257(28 Aug 1973).

The GR 1 radiation damage center in diamond was studied by means of optical absorption and uniaxial stress. Two zero-phonon lines at 1.665 and 1.673 eV are associated with the defect, and an energy level scheme is proposed to explain the thermal behavior of the lines. The energy-level diagram facilitates the interpretation of the uniaxial stress data, and it is concluded that the defect possesses tetrahedral symmetry. Comparison of the energy level scheme derived experimentally with theoretical treatments of intrinsic defects in diamonds suggests that the GR 1 center is probably the neutral vacancy. (auth)

25258 F-CENTER ANNEALING BY POSITRON IRRADIATION. Aref'ev, K. P.; Vorob'ev, S. A. (Tomsk Polytechnical Inst., USSR). Phys. Lett.; 44A: No. 6, 439-440(16 Jul 1973).

The bleaching of a colored KBr single crystal after the position irradiation was observed. The F-center annealing is attributed to the influence of the holes induced by positron annihilation. (auth)

25259 PARAMAGNETIC CENTERS IN SILICON IRRADIATED WITH HEAVY CHARGED PARTICLES. Botvin, V. A.; Gorelkinskii, Y. V.; Sigle, V. O.; Chubisov, M. A. (Institute of High-Energy Physics, Academy of Sciences of the Kazakh SSR, Alma-Ata). Sov. Phys.-Semicond. 6: No. 9, 1453-1456 (Mar 1973).

The ESR method was used to study paramagnetic centers generated in silicon single crystals by irradiation with 37-MeV α particles or 9-MeV protons at 273°K. The experiments were carried out on silicon grown by the floating-zone and Czochralski methods and doped with P^{31}, B^{11}, and A^{27}. The existence of Si-P3, Si-P1, Si-P4, Si-P5, Si-S1 (Si-B2), and Si-S2 centers was established in the proton-irradiated samples. The Si-S1 and Si-S2 centers were not found in the α -irradiated silicon. The characteristics of isochronous annealing of the various centers were determined. The distribution of the paramagnetic centers along the trajectories of the incident particles was determined by successive removal of silicon layers from the irradiated side. The rates of introduction of the paramagnetic centers by α particles and protons were estimated. (auth)

25260 INVESTIGATION OF PROTON RADIATION DAMAGE OF SI AND GE SINGLE CRYSTALS BY THE SHADOW EFFECT. Kolyada, V. M.; Zlobin, V. G.; Zaporozhets, I. A. (All-Union Scientific-Research Institute of Analytic Instrument Manufacture, Kiev). Sov. Phys.-Semicond. 6: No. 9, 1565-1567 (Mar 1973).

Single crystals of Si and Ge with their surfaces parallel to the (III) plane were bombarded with 43, 50, 63, and 83 keV protons falling on the samples at an angle of 40°. The relative depths of the axial shadow were plotted as a function of proton dose. It was shown that the shadow effect can be used to study the kinetics of accumulation of defects in a crystal and to estimate the radiation stability of the lattice of a single crystal. (CES)

25261 PHASE TRANSITION IN IRRADIATED GADOLINIUM MOLYBDATE. Dem'yanov, V. V.; Shchedrin, M. I. Sov. Phys.-Solid State; 14: No. 10, 2620-2621(Apr 1973).

Experimental data on the influence of reactor radiation on the temperature of the phase transition in $Gd_2(MoO_4)_3$ are reported. The measurements were carried out at 50 kHz. The sample was irradiated in a water-filled channel. When the total dose of fast neutrons reached 1.5×10^{18} cm^{-2}, the temperature dependence of the permittivity of a "free" crystal, $\epsilon'(T)$, was determined. Then the same crystal was irradiated additionally under the same conditions until the dose reached 6×10^{18} cm^{-2}. The results are presented in a phase diagram. The irradiation shifted the temperature, T_m, of the λ permittivity peak in the direction of higher temperatures according to the law $T_m = T_C + A\Phi$, where $A = 28 \times 10^{-18}$ deg · cm^2 and T_C is the Curie point of the unirradiated crystal. The shift of T_m was practically irreversible at temperatures of 600 to 800°C. The nature of the temperature anomaly of $\epsilon'(T)$ was practically the same before and after irradiation. It was concluded that the shift of T_C resulting from irradiation is due to internal stresses that are generated by radiation defects. (1 figure) (RWR)

25262 DEFECTS IN NEUTRON-IRRADIATED STRONTIUM TITANATE: Ti^{3+} OFF-CENTER ON A Sr^{2+} SITE. Schirmer, O. F. (Institut für Angewandte Festkörperphysik der Fraunhofer-Gesellschaft, D 7800 Freiburg, Federal Republic of Germany); Müller, K. A. Phys. Rev. B 7: No. 7, 2986-2995 (1 Apr 1973).

Nominally pure $SrTiO_3$ crystals show, after irradiation with fast neutrons, paramagnetic-resonance (EPR) spectra arising from Ti^{3+} ions on Sr^{2+} sites. Because of its smaller radius, the Ti^{3+} sites off-center. In the tetragonal low-temperature phase of $SrTiO_3$ ($T < T_c \simeq 015$ K) it moves towards one of the twelve surrounding oxygen ions roughly 0.03 Å in a direction perpendicular to the domain axis. This is proved by the response of the EPR spectra to the application of external electric fields. For $T > T_c$ simultaneously another Ti^{3+} spectrum is seen, which results from a partial averaging of the low-temperature spectrum. The coexistence of both types of spectra is attributed to the critical dynamics of the fluctutations of the order parameter ϕ near T_c. For $T = (T_c + 4) \pm 0.5$ K a frequency spread of $\Delta\nu = 3.5 \times 10^8$ Hz is obtained corresponding approximately to the width of the central mode. (auth)

25263 RARE EARTH INTERCALATION AND MAGNETIC PROPERTIES OF LAYER-TYPE COMPOUNDS. Subba Rao, G. V.; Shafer, M. W.; Tao, L. (IBM Research Center, Yorktown Heights, NY). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 10, 1173-1177 (1973).

From 18th annual conference on magnetism and magnetic materials; Denver, Colorado, USA (28 Nov 1972). See CONF-721114-P2.

Eu, Yb, and Sr were intercalated in the layered MoS_2. The intercalations were carried out at low temperatures in liquid ammonia solutions and were shown to be free of the ferromagnetic impurities $Eu(NH_2)_2$ and $Eu(NH_3)_6$. Lattice parameter increases in the c direction of the hexagonal cell, independent of the concentration of the intercalated species, from 18.39 Å for pure 3R MoS_2 to 27.84 for the Eu intercalated material were measured. The intercalated species is found to go between every layer and ammonia is intercalated along with the metals. The composition of MoS_2 fully intercalated with Eu is $MoS_2(Eu)_{0.9-1.0}(NH_3)_{1-1.5}$. MoS_2 orders ferromagnetically at 4-5°K when intercalated with Eu in concentrations greater than $MoS_2(Eu)_{0.5-0.6}$. The ferromagnetic composition has paramagnetic Curie temperatures of 8-9°K and Curie constants consistent with the europium being all divalent, i.e., $C_M = 7.9$. When Yb and Sr are intercalated in MoS_2, superconductivity occurs at 2.8 and 5.2°K respectively. (auth)

25264 MAGNETIC PROPERTIES OF ANTIFERROMAGNETIC NpP. Lander, G. H.; Dunlap, B. D.; Lam, D. J.; Harvey, A.; Nowik, I.; Mueller, M. H.; Aldred, A. T. (Argonne National Lab., IL). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 10, 88-92(1973).

From 18th annual conference on magnetism and magnetic materials; Denver, Colorado, USA (28 Nov 1972). See CONF-721114-P1.

Neptunium phosphide has the NaCl-type structure with a lattice parameter of a = 5.610 Å. The compound orders antiferromagnetically at 120°K. Between 120 and 74°K, the magnetic moments are arranged in a longitudinal sinusoidal modulation with the spin direction parallel to the cube axis, and with a constant repeat distance of 2.78 ± 0.08 unit cells. Below 74°K the spin structure becomes commensurate with the lattice, having a repeat of 3 unit cells, and higher-order harmonics in the neutron pattern indicate a tendency towards forming a square 3+, 3- wave. At 4.2°K, however, the process is incomplete, the two neptunium magnetic moments being 2.4 and 1.8 μ_B. The Moessbauer spectra at 4.2°K can be explained by assuming two different hyperfine fields of 3690 ± 40 kOe and 4210 ± 40 kOe at the Np site, with an occupation ratio of two to one. This interpretation is in agreement with the neutron results. Magnetization and resistivity measurements both indicate transitions at 120°K (T_N) and 74°K. The resistivity falls sharply at 74°K, and such a change is compatible with the decrease in magnetic scattering that occurs when the ordering becomes commensurate. (auth)

25265 EXISTENCE OF THE FCC URANIUM. Tudja, M.; Ban, Z. (Rudjer Boskovic Inst., Zagreb). Croat. Chem. Acta; 45: No. 2, 371-376(1973).

Diffusion studies in the system U-S, employing the couples U-US, U-US_2, and U-U_3S_5 revealed the existence of new fcc phase with the composition ranging from approx. $U_{20}S$ to U_8S. The lattice parameter of the phase as obtained in the diffusion couple is 4.95 ± 0.01 Å. The same phase can be also obtained by the arc melting of the mixtures of U and US or U and S in the appropriate proportions, if followed by the heat treatment at 1900°C during at least four hours. It is believed that this is a crystal structure modification of uranium stabilized by the addition of a small quantity of nonmetal atoms, where S and N play a major role. The same phase has been obtained through the addition of approximately 9 at. % of Se, Te, P, As, Sb, Bi, C, and Si. Although the effect of the stabilization is not yet completely understood, all samples contain a fcc phase and possess virtually the same lattice parameter as the phase containing sulfur. The experimental density is 14.21 g cm^{-3}. The calculated density is 13.21 g cm^{-3}. (auth)

25266 EFFECT OF IRRADIATION ON THE POLYCHLOROPRENE STRUCTURE. Satina, T. Ya.; Aslanyan, K. A.; Arshakuni, R. G.; Bagdasaryan, R. V.; Chryan, M. B. (All-Union Scientific Research Inst. of Polymer Products, Erevan). Vysokomol. Soedin., Ser. B; 15: No. 6, 407-409(Jun 1973). (In Russian).

The effect of γ radiation on the structure of polychloroprene rubber was investigated. At small radiation doses the thermo-

radiation effect leads to a secondary crystallization. The radiation processing at room temperature decreases the degree of crystallinity of the polychloroprene only about 5%. With thermoradiation processing with increased doses of radiation up to 16 Mrad the crystallinity completely disappears. (tr-auth)

25267 THERMAL RECOVERY OF RADIATION HARDENING ACCOMPANIED BY TL AND THERMAL DECAY OF THE V_1 BAND IN Na-DOPED KBr. Okada, T.; Tanimura, K.; Suita, T. (Osaka Univ., Suita, Japan). Phys. Status Solidi (b); 59: No. 1, K39-K42 (1 Sep 1973).

KBr single crystals containing 90 ppM Na were irradiated for 45 h at 4.2°K with ^{60}Co γ rays at a dose rate of 2.5×10^5 R/h. The thermal annealing behavior of $\Delta\tau$ (flow stress increase), thermoluminescence (TL), and several absorption bands (F, V_1, V_4, and V(.306)) was compared. The characteristics of stages I, II, and III are listed, and correlations between $\Delta\tau$ and thermal decay of V_1 and TL glow peaks are made. (DLC)

25268 INTERACTIONS OF Si(111) SURFACES WITH OXYGEN BY ELECTRON-BOMBARDMENT SURFACE ION DESORPTION TECHNIQUE. Nishijima, M. (Mitsubishi Electric Corp, Amagasaki, Japan). Jap. J. Appl. Phys.; 11: No. 9, 1284-1292(Sep 1972).

A study was made of the electron-bombardment surface ion desorption from Si(111) with chemisorbed oxygen. For 100-eV electrons, the maximum ion yield is estimated to be $\sim 10^{-7}$ ions/electron, and the ion energy distribution has a maximum at 4.5 eV with a half width of 6.1 eV. The distribution is quite asymmetrical and extends from zero to 16.1 eV. The threshold energy for desorption of zero-energy ions is 15.7 eV. (JA)

25269 THERMAL STABILITY OF E-41 EPOXY RESIN AFTER γ IRRADIATION. Bakaeva, V. P.; Egorova, V. P.; Karov, V. L. Plast. Massy; No. 5, 20-24(1973). (In Russian).

Results are described from a study by the methods of mass spectrometry, derivatography, and infrared spectrometry of the thermal stability of epoxy resins congealed by different congealants and subjected to gamma radiation in the dosage range of 50 to 1,000 Mrads. The thermal stability of the uncongealed epoxy resin depends on the molecular weight, and the thermal stability of the congealed epoxy resin after irradiation and the radiation resistance depend on the type of congealant. The thermal destruction of the nonirradiated and irradiated congealed epoxy resins depends on the irradiation medium. The quantity and composition of the gases released during irradiation of the epoxy resins congealed by different congealants will depend on the irradiation temperature. (JPRS)

25270 RADIATION MODIFICATION OF INORGANIC MATERIALS. Solov'eev, S. P.; Kuz'min, I. I. Zh. Vses. Khim. Obshchest. im. D. I. Mendeleeva; 18: No. 3, 308-312(1973). (In Russian).

A review with 41 references is given on the effect of radiation on inorganic nonmetallic materials. In general, γ irradiation increased the catalytic activity of the materials tested. Radiation also proved to be beneficial in case of piezoceramic materials designed for strong electric fields, lowering the nonlinearity of the relationship between dielectric permeability and the voltage applied, and decreasing the dielectric losses. The ageing process increases under the influence of γ irradiation. Finally, radiational modification can be used in alloying silicon materials uniformly throughout even large crystals. (JPRS)

25271 INTERACTION OF NITROGEN WITH MAGNESIUM, TITANIUM, ZIRCONIUM, AND NIOBIUM POWDERS AND THEIR MIXTURES WITH NITRIDES. Samsonov, G. V.; Polishchuk, V. S. J. Appl. Chem. USSR (Engl. Transl.); 46: No. 3, 509-512(Mar 1973). Translated from Zh. Prikl. Khim.; 46: No. 3, 481-485(Mar 1973).

The interaction of metallic Mg, Ti, Zr, and Nb powders with nitrogen was studied as part of an investigation of the production of nitrides of these metals. A method is proposed for moderation of the temperature effects of interaction of these metallic powders with nitrogen by addition of nitrides to the metallic powders. It was found that additions of the more refractory nitrides to metallic powders raise substantially the ignition temperatures of the metals in nitrogen, prevent fusion of the metal particles at the instant of ignition, and favor improvement of the gas permeability of the charge and of the technological properties of the products. (auth)

NUCLEAR MATERIALS AND WASTE MANAGEMENT

Accountability and Safeguards

25272 (IAEA-R-999-F) SAFEGUARDS STUDY OF THE WESTINGHOUSE CANADA LIMITED FUEL FABRICATION PLANT. Final Report, 1 January 1971–31 December 1971. Howieson, J. (International Atomic Energy Agency, Vienna (Austria)). Mar 1972. 37p. INIS.

The results of a safeguards study of the Westinghouse Port Hope plant that fabricates uranium fuel elements of two types, i.e., low enriched or natural oxide type and highly enriched UA1 fuel is presented. The study was carried out through 1971 and considers all fuel fabrication during that period. In addition, the plant's previous practice in handling nuclear materials has been reviewed and summarized. The nuclear material accounting practice is considered in the report as well as the accuracy of the weighing method for the several important items of the material balance, such as input UO_2 powder, UO_2 pellets (green, sintered, ground), pellet stacks, UA1 billets, and UA1 cores. Data from several inventories taken are presented and procedures of an inventory taking are described. Measurement accuracies and errors are considered with the emphasis on random errors. Book inventory data from previous UO_2 fuel fabrication campaigns (1965 to 69) show that values of BAP (Balance After Processing) are generally below 3% with the majority of the values at 1% or less. Values of BAP for the past UA1 campaigns are usually below 1%. Present accounting practice shows that for incoming UO_2 powder, shipper/receiver differences (as average of eight cases) are 0.07%. For pellets, the potential error in uranium determination is less than ±0.04%. The weight of a bundle could differ from the average bundle weight recorded by the ±1.5%. The data for one of the last campaigns shows an MUF figure of 0.32 ± 0.7%. (NTIS)

25273 (LA-5291-PR) NUCLEAR ANALYSIS RESEARCH AND DEVELOPMENT. Program Status Report, January–April 1973. Keepin, G. R. (Los Alamos Scientific Lab., N. Mex.). May 1973. Contract W-7405-eng-36. 24p. Dep. NTIS $4.00.

The status of the nondestructive assay R & D program of the LASL Nuclear Analysis Research Group, A-1, covering the period from Jan. 1 through April 30, 1973, is discussed. The program status report includes the following subjects: neutron interrogation (active) assay applications and results; passive assay applications and results; detector and instrumentation development, and materials identification and analysis with stopped muons. (LCL)

25274 PRACTICAL ASPECTS OF NUCLEAR FUEL SERVICES MANAGEMENT. Avery, D. G.; Carter, P. E. (British Nuclear Fuels Ltd., Risley, Eng.). Energy Dig.; 1: No. 1, 9-17 (Aug 1972).

A problem fundamental to all stages of production planning is that of balancing high utilization of expensive plants and minimum hold-up of expensive materials. The fuel services required for an oxide-fuelled, enriched uranium, thermal reactor are used as an example. A material flow diagram is presented and discussed. Consideration is given to the production of uranium hexafluoride, enrichment, fuel fabrication and reprocessing. The techniques of production planning are described, including the planning of capital investment. (UK)

Disposal and Storage

Refer also to abstract 24461.

25275 (TID-3343) RADIOACTIVE WASTE MANAGEMENT. A Bibliography of Publicly Available Literature Pertaining to the USAEC's Oak Ridge, Tenn., Site. (Technical Information Center (AEC), Oak Ridge, Tenn.). Sep 1973. 89p. TIC Free.

This bibliography contains abstracts of 448 technical reports and journal articles which have appeared in Nuclear Science Abstracts from 1948 through July 1973 pertaining to radioactive waste management at the Oak Ridge site. The abstracts are grouped into ten categories. Within the categories, they are arranged by NSA volume and abstract number. (TFD)

25276 PROCEDURE FOR THE ADSORPTION OF RESIDUAL GASES OF NUCLEAR TECHNICAL PLANTS, ESPECIALLY FOR THE REMOVAL OF HYDROGEN GAS FROM AIR. Fabian, H. (to Nuklear Chemie und -Metallurgie GmbH). German Patent 2,138,241. 8 Feb 1973. 9p. (In German).

A method for the removal of hydrogen gas, particularly tritium, from the air and waste gases of nuclear technical plants is described. The hydrogen is converted into H_2O by means of a catalyst (e.g., copper oxide) and bound to solid material (P_2O_5) drying agents. In the case of spasmodic yields of larger amounts of gas, it is necessary to transfer it to gas storage equipment. (GE)

Handling Equipment and Procedures

Refer also to abstracts 24507 and 24510.

25277 (AERE-R-6702) LEAD-SHIELD-MICRO HANDLING CELL FOR COATED FUEL PARTICLES. Brown, P. E.; Campbell, D.; Evans, J. H.; May, F. J. (Atomic Energy Research Establishment, Harwell (England)). May 1971. 35p. Dep. NTIS (U. S. Sales Only) $3.75.

It is of interest to the fuel manufacturer and the safety assessor to have statistical information on the burn-up and temperature behavior of coated particle fuel to be used in future High Temperature Reactors. One approach to providing this information is to irradiate a large number of candidate fuel particles in graphite trays and examine each particle after irradiation. A lead shielded cell specifically built to handle this type of experiment and the optical and micro-manipulator equipment used to locate and select defective particles for further examination are described. The cell has been used to examine several loose particle experiments from both the UKAEA Mk.III Gas Cooled Reactor Project and also the DRAGON Project programmes. As an example, details are given of the procedures adopted in the post-irradiation examination of the Statistical Experiment irradiated in the DRAGON reactor in which approximately 4×10^5 coated particles have been tested. (auth)

25278 (INR-1428) CRITICALITY PROBLEM IN THE TECHNOLOGICAL PROCESS OF THE $CaUF_6$ PRODUCTION ENRICHED TO 80% ^{235}U. Zoltowski, T.; Parus, J. (Institute of Nuclear Research, Warsaw (Poland)). 1972. 41p. (In Polish). Dep. NTIS (U. S. Sales Only) $4.25.

Theoretical analysis of the $CaUF_6$ production process from the criticality point of view was performed using the computer program written in FORTRAN language for Control Data 3170 computer. Calculations were carried out to determine criticality parameters of the cylindrical vessels which represents particular elements of the process assembly. Criticality data were computed from the criticality equation which compares the material and geometrical buckling. Each step of the technological process was discussed and the recommended safe solutions for the apparatus design indicated. The detailed analysis of the production process of 1.24 kg $CaUF_6$ with 80% enrichment was also performed. The work describes the general method for the analysis of any criticality problem related to the production and reprocessing of nuclear reactor fuels. (auth)

25279 PROCESS FOR EXTRACTING FUEL ELEMENT CANS FROM REACTORS, IRRADIATION CAPSULES, TRANSPORT, OR STORAGE CONTAINERS, IN VACUUM, HIGH VACUUM, OR UNDER HIGH PRESSURE. Dorner, S.; Schretzmann, K.; Reiss, F. (to Gesellschaft fuer Kernforschung mbH). German Patent 1,589,815. 14 May 1970. Filed date 3 Mar 1967. (In German).

A procedure is described for removing fuel element cans from reactors, from irradiation capsules, or from storage containers or transport containers in vacuum, high vacuum, or under high pressure. This procedure is characterized by the fact that the object to be cut up is directed by remote control to the cutting height in the interior of a high-frequency coil of suitable form. The high-power circuit is engaged until melted at the point of cutting, and the two parts are separated. (TSS)

25280 CRITICALITY OF HIGH BURNUP PLUTONIUM. Lloyd, R. C.; Clayton, E. D. (Battelle-Pacific Northwest Labs., Richland, WA). Contract AT(45-1)-1830. Nucl. Sci. Eng.; 52: No. 1, 73-75(Sep 1973).

A series of criticality experiments were completed with plutonium nitrate solutions made up from extremely high burnup fuel (^{239}Pu isotopic concentration $< \frac{1}{2}$ total Pu). The measurements were performed on a large, 61-cm-dia, water-reflected, cylindrical vessel. The critical experiment data were analyzed by means of the KENO Monte Carlo code utilizing both ENDF/B-II and -III cross sections; the computed criticality factors were in the range of 1.6 to 1.9% above unity. The effects of the various heavy element isotopes on criticality were analyzed. The results show the importance of properly accounting for, and treating, the effects of each of the various isotopes in com-

puting criticality. Even the presence of as little as 1% of ^{241}Am can cause a change in the reactivity of the solutions used in these experiments by ~1%. (auth)

Transportation

25281 (AERE-R-7003) DESCRIPTION OF VARIOUS TEST METHODS USED AT A.E.R.E., HARWELL, TO COMPLY WITH THE I.A.E.A. REGULATIONS FOR RADIOACTIVE TRANSPORT CONTAINERS. Davies, A. J. (Atomic Energy Research Establishment, Harwell (England)). Feb 1972. 37p. Dep. NTIS (U. S. Sales Only) $4.00. UK pounds 1.00.

Methods of conducting various tests carried out at A.E.R.E. Harwell to satisfy the I.A.E.A. Regulations and other non-mandatory tests desirable to prove transport container design are described. (auth)

25282 TRANSPORT CASK FOR RADIOACTIVE MATERIAL. Beierle, F. P. (to Chem.-Nuclear Systems, Inc.). U. S. Patent 3,754,140. 21 Aug 1973. Filed date 2 Dec 1970. 6p.

A cask assembly is described for the transport of radioactive material comprising a shielded cylindrical cask slidably received within a cask overpack. The assembly is supported on the bed of a truck within an encircling cradle. The overpack comprises inner and outer cylindrical shells filled by directionally oriented honeycomb material designed to withstand external forces without rupture of the protective cask or containment vessel. (Official Gazette)

25283 CONTAINER FOR RADIOACTIVE SUBSTANCES. Pfeifer, W. (to Transnuklear GmbH). German Patent 1,908,001. 3 Sep 1970. Filed date 18 Dec 1969. (In German).

A container for radioactive materials is described in which at the point of contact between the cover and the vessel there is formed a water- and air-tight rim that is sunk into the body of the vessel when the vessel is closed by threading. (TSS)

25284 CASK FOR TRANSPORTING IRRADIATED FUEL ELEMENTS. (to Commissariat a l'Energia Atomique). French Patent 2,150,569. 12 Jul 1971. 8p. (In French).

A cask for the transport of irradiated fuel elements is described. The system is provided with a shell containing several cells, which are closed with lead plugs, these plugs being protected by a cowling and a central cavity lined with an indothermic material. The shell is partially enclosed by a neutron shield. A heat exchanger is fixed (the fixation being dismountable) to an external radiator and possibly to a complementary shield facing the heat exchanger. The shell, which is generally cylindrical, is constructed from a number of steel skirtings having decreasing diameters. The cells are also constructed with stainless steel. The gap between the cells and the shell is filled with lead. (FR)

PARTICLE ACCELERATORS

Design, Development, and Operation

Refer also to abstracts 25322 and 26188.

25285 (CONF-711151-S2) HEAVY ION SCIENCE. Proceedings of Tokai Meeting, November 29–December 1, 1971. (Japan Atomic Energy Research Inst., Tokai. Tokai Research Establishment; Institute of Physical and Chemical Research, Tokyo (Japan)). 1972. 194p. (In Japanese and English).

Twenty-two papers are presented on various aspects of heavy-ion accelerators and solid state physics, chemistry, and biology with heavy ions. Topics include interactions of fission products with crystal lattices, channeling, radiation damage, engineering studies of reactor material with heavy ions, superheavy elements, recoil properties of heavy ion reaction products, ion-molecule reactions using heavy-ion accelerators, heavy-ion induced fission, radiolysis with heavy ion beams, yields of hydrated electrons in aqueous system irradiated with the recoil from the $^{10}B(n,\alpha)^{7}Li$ and $^{6}Li(n,\alpha)T$ reactions, irradiation of biological cells with heavy ions, bacterial inactivation by heavy ions, and radiotherapy with high LET radiation. The papers are in Japanese with brief summaries in English. (WHK)

25286 (LA-5358-PR) MEDIUM-ENERGY PHYSICS PROGRAM. Quarterly Report for the Period Ending April 30, 1973. Dunn, E. (comp.) (Los Alamos Scientific Lab., N. Mex.). Jul. 1973. Contract W-7405-eng-36. 51p. Dep. NTIS $5.45.

Work this quarter has continued on the development of the experimental areas and improving the reliability and reproducibility of accelerator operation. The accelerator was operated continuously for 12 days. The H^- injector was turned on for the first time on March 28, 1973. On April 6, we were successful in simultaneously accelerating H^+ and H^- ions to 100 MeV, with peak currents of 50 μA for H^- and 200 μA for H^+. (auth)

25287 (LA-tr-73-42) MAIN PROBLEMS OF HIGH-POWER LINEAR ACCELERATORS OF PROTONS. Bondarev, B. I.; Ivanov, I. D.; Kul'man, V. G.; Murin, B. P.; Mirochnik, E. A.; Poliakov, B. I.; Neviazhskii, I. K.; Solov'ev, L. I.; Khesets, E. A. Translated by A. D. Cernicek from Tr. Radiotekh. Inst.; No. 1, 49-75(1970). 24p. Dep. NTIS $3.25.

A short review of the development of technology of linear accelerators of protons is given and the main problems arising when developing high-power linear accelerators of protons with an energy of the order of 1000 MeV are discussed. In particular, the singularities of particle dynamics and automatic control systems are examined, as well as the problems of constructing accelerating structures and systems of high-frequency power supply, and also some engineering problems arising in connection with large mean outputs, radiation emissions and a possibility of activating accelerator elements. (auth)

25288 (RL-73-68) PROPOSED REFERENCE NUMBERING SYSTEM FOR EPIC LATTICE COMPONENTS. Loach, B. G. (Rutherford High Energy Lab., Chilton (England)). Jul 1973. 32p. Dep. NTIS (U. S. Sales Only) $3.75.

It will be desirable with a machine as large and complex as EPIC (in fact essential for many purposes), to be able to refer specifically to any item in the ring lattice structure and know immediately where that item is located. A suitable numbering system is proposed. (UK)

25289 8 MeV VAN DE GRAAFF PROTON TANDEM ACCELERATOR STUDIES AT CISE. Milazzo, M. (CISE-Segrate, Milan). Elettrotecnica, Suppl.; 59: No. 4, vp.(1972). (In Italian).

The 8-MeV Van de Graaff proton accelerator developed at CISE is described in detail. The electrostatic generator, the behavior of the accelerator tube under voltage, the accelerator optical system, the control console, the stabilization of the voltage, stabilization with the corona discharge, stabilization with the capacitive system, slow lens, and the fast lens are discussed. Preliminary results of its operation are reported. (JSR)

25290 ALIGNMENT OF THE ACCELERATING ELECTRODES IN AN ACCELERATOR HAVING QUADRUPOLE RF FOCUSING. Stepanov, V. B.; Mal'tsev, A. P.; Zhuravlev, I. A.; Teplyakov, V. A.; Sevost'yanov, V. S. Instrum. Exp. Tech. (USSR) (Engl. Transl.); 15: No. 6, 1634-1635(1972).

Translated from Prib. Tekh. Eksp.; 15: No. 6, 20-21(1972).

A method is described for the highly accurate mounting of an accelerating electrode in a linear proton accelerator having quadrupole rf focusing. The electrodes were mounted on the resonator axis by means of a special bench and are fastened by soldering with a solder having a small shrinkage. The mounting accuracy is 30 to 40 μ. (auth)

25291 COMPACT TUBE WITH A COLD CATHODE FOR OBTAINING NANOSECOND PULSES OF FAST ELECTRONS. Pavlovskaya, N. G.; Kudravtseva, T. V.; Dron, N. A.; Sloeva, G. N.; Tsvetkov, L. V. Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 1, 18-20(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 1, 19-21(1973).

The sealed two-electrode compact tube with a cold cathode and a beryllium window is designed to obtain nanosecond pulses of fast electrons. At an accelerating voltage of 200 kV with a leading-edge slope $\sim 10^{14}$ V/sec, $\sim 5 \times 10^{12}$ electrons emerge into the atmosphere during a time ~2 nsec. The maximum amplitude of the electron-current beam reaches 400 A. The efficiency of the tube varies from 2 to 20% as a function of the magnitude of the voltage. The tube operates in a mode with single turn-ons and at frequencies of up to 10 Hz. The availability of working pulses exceeds 2×10^5. (auth)

25292 LINEAR 550 keV PROTON ACCELERATOR HAVING ASYMMETRICAL ALTERNATING-PHASE FOCUSING. Kushin, V. V.; Zarubin, B. T.; Svirin, V. V.; Chistyakova, N. M. Instrum. Exp. Tech. (USSR) (Engl. Transl.); 15: No. 6, 1628-1630(1972).

Translated from Prib. Tekh. Eksp.; 15: No. 6, 15-17(1972).

Results are presented of an investigation of the modes of a proton accelerator operating in the energy range from 50 to 560 keV at a frequency of 150 MHz, in which the focusing of the particles is ensured by the accelerating field itself. It was established that the capture of the accelerator (without the buncher) is close to 20%, while the reduced emittance of the beam at the output is equal to $\pi \cdot 0.36$ mrad $\cdot$ cm and the energy spread is ±2%, which is in agreement with calculations performed previously. The results obtained are evidence of the feasibility of performing experiments on increasing the accelerated currents and provides a hope that it will be possible to use this form of focusing in larger accelerators. (auth)

25293 DEMONSTRATION OF THE SUPERCONDUCTING ELECTRON ACCELERATOR AS A HIGH-INTENSITY HIGH-RESOLUTION DEVICE. McAshan, M. S.; Mittag, K.; Schwettman, H. A.; Suelzle, L. R.; Turneaure, J. P. (Department of Physics and High Energy Physics Laboratory, Stanford University, Stanford, California, 94305). Appl. Phys. Lett. 22: No. 11, 605-607 (1 June 1973).

In recent experiments with the superconducting injector system, beam intensity and beam quality objectives for the superconducting electron accelerator have been achieved and exceeded. At 8.5 MeV and 25 μA, spreads in phase and energy of 1.2° and 9.2 keV fullwidth at half-maximum, respectively, have been measured, and at 250 μA the spreads in the phase and energy increased by only 10%. (auth)

Auxiliaries and Components

25294 (LA-5376-MS) REFLECTIONS CONCERNING CRITERIA FOR DESIGN OF A HIGH-GRADIENT ACCELERATING TUBE. McKibben, J. L. (Los Alamos Scientific Lab., N. Mex.). Sep 1973. Contract W-7405-Eng-36. 23p. Dep. NTIS $4.00.

The difficulty of designing a high-gradient accelerating tube is emphasized. In an effort to recognize all the factors involved in discharges and sparking within an accelerating tube, a list of 15 criteria for construction of a good tube is discussed. The experience that has led to the development of the criteria is traced from development work at the University of Wisconsin through the design and development of the large vertical Van de Graaff of LASL's Group P-9. Finally, the design of a tube that meets these criteria is sketched and it is suggested that such a tube might be capable of operating at a gradient of 3 to 4 MV/m. (auth)

25295 MONITORING HIGH-ENERGY ELECTRON BEAMS. Stratienko, V. A. (Physical-Technical Inst., Kharkov). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 15: No. 6, 1645-1647(1972).

Translated from Prib. Tekh. Eksp.; 15: No. 6, 28-30(1972).

A method is described for monitoring intense electron beams which is based on the detection of secondary-emission electrons whose energy greatly exceeds the work function of electrons from the emitter (so-called δ-electrons). Prolonged measurements of the emission coefficient of δ-electrons for a primary-electron energy of 30 MeV yielded deviations from the average value which were within the limits of the instabilities of the measurement equipment (~0.5%). Under these conditions the emitter (Al foil 0.1 mm thick) was mounted directly in the vacuum system of the accelerator. (auth)

25296 SECONDARY-EMISSION MONITOR OF THE POSITION AND CURRENT OF A BEAM OF ACCELERATED ELECTRONS. Prudnikov, I. A.; Toropov, A. S.; Chichikalov, Yu. F. (Scientific-Research Inst. of Electrophysical Equipment, Leningrad). Instrum. Exp. Tech. (USSR) (Engl. Trans.); 16: No. 1, 21-23(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 1, 24-26(1973).

The construction and results of tests of a secondary-emission monitor of the position and current of a beam of accelerated electrons are considered. The monitor has a high sensitivity, a simple construction, compact dimensions, and has a negligible effect on the beam parameters. (auth)

25297 BREMSSTRAHLUNG FLUXMETER. Aleksandrov, Yu. A.; Kozlov, V. A.; Kutsenko, A. V.; Maikov, V. N.; Pavlovskaya, V. V. (Inst. of Physics, Moscow). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 1, 108-110(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 1, 96-98(1973).

A relative monitor that monitors the intensity of the bremsstrahlung from the 680-MeV synchrotron of the Physics Institute of the Academy of Sciences of the USSR is described. The removal of the charge from the measurement ionization chamber and the application of the charge to the chamber in order to monitor the entire channel is achieved by means of precision mechanical relays. The value of a monitor reading does not fluctuate by more than ±1.5% over a prolonged period. The magnitude of the monitor reading is a linear function of the instantaneous bremsstrahlung dose. (auth)

25298 MEASUREMENT OF THE TRANSVERSE VELOCITIES OF ELECTRONS IN AN INTENSE STATIONARY BEAM. Ginkin, V. P.; Meshkov, I. N.; Skrinskii, A. N.; Fainshtein, V. G. (Inst. of Nuclear Physics, Novosibirsk, USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 15: No. 6, 1642-1644(1972).

Translated from Prib. Tekh. Eksp.; 15: No. 6, 26-28(1972).

A method is described for measuring the transverse velocities of electrons moving in a longitudinal magnetic field by means of pulsed deflection of the beam in an analyzing device. The device consists of an "iris" (a plate with a set of apertures having a small diameter) and a luminescent screen that is moved along the axis of the deflected beam. The dependence of the shape and dimensions of the image on the distance between the "iris" and the screen allow the transverse velocities of the particles in the beam to be estimated. A resolution of about $5 \cdot 10^{-3}$ was obtained. (auth)

25299 STABILIZATION OF THE PARTICLE ENERGY IN ACCELERATORS HAVING A TUNED CIRCUIT. Dorofeev, G. L.; Cherepkov, V. G. (Inst. of Nuclear Physics, Novosibirsk, USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 15: No. 6, 1631-1633 (1972).

Translated from Prib. Tekh. Eksp.; 15: No. 6, 18-20(1972).

An LC tuned circuit having threshold negative feedback is considered which converts a portion of the energy stored in it into the energy of a beam of accelerated particle. An equation is derived for the relative instability of the accelerating voltage. A family of characteristics which are suitable for estimating the boundaries of the energy spectrum of the accelerated particles is presented for a broad class of accelerators having a tuned circuit. (auth)

25300 SUPERCONDUCTING PULSED MAGNETIC SYSTEMS FOR HIGH ENERGY SYNCHROTRONS. Hein, W. (Kernforschungszentrum, Karlsruhe, Ger.). pp 55-63 of Proceedings of the Fourth International Cryogenic Engineering Conference. Guildford, Eng.; IPC Science and Technology Press Ltd. (1972).

From 4th international cryogenic engineering conference; Eindhoven, Netherlands (24 May 1972). See CONF-720565-.

Superconductivity is becoming more and more important for future accelerators and for improving existing ones. The higher magnetic fields attainable allow an increase in energy by a factor of 3 to 4 when the geometry is kept constant. Especially attractive is the possibility of converting an existing proton synchrotron to higher energies by replacing conventional iron magnets with superconducting magnets. Therefore, pulsed superconducting magnets which meet all the requirements of a synchrotron magnet have to be developed with the necessary cryogenic facility. The problems, state of the art and experience with conductors, magnets and cryostats are discussed. (auth)

25301 CRYOGENIC SYSTEMS FOR SUPERCONDUCTING LINEAR ACCELERATOR SYSTEM AND PARTICLE SEPARATOR PROJECTS. Barth, W.; Flecher, P.; Graf, F.; Green, M. A.; Herz, W.; Huetten, L.; Katheder, H.; Lehmann, W.; Spath, F.; Winkler, G. (Kernforschungszentrum, Karlsruhe, Ger.). pp 101-107 of Proceedings of the Fourth International Cryogenic Engineering Conference. Guildford, Eng.; IPC Science and Technology Press Ltd. (1972).

From 4th international cryogenic engineering conference; Eindhoven, Netherlands (24 May 1972). See CONF-720565-.

The cryogenic systems installed at Karlsruhe in connection with the LINAC, separator and magnet projects are discussed together with experimental experiences with different cryostats in connection with the refrigerator. (auth)

Ion Sources and Injection and Extraction Systems

Refer also to abstract 25293.

25302 INCREASING THE INTENSITY OF THE BEAM FROM A LINEAR PROTON ACCELERATOR. Batalin, V. A.; Kapchinskii, I. M.; Kolomiets, A. A.; Kondrat'ev, B. K.; Kuibida, R. P.; Kuznetsov, V. S.; Kuznetsova, N. P.; Trubnikov, G. I. (Inst. of Theoretical and Experimental Physics, Moscow). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 1, 9-13(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 1, 15-18(1973).

Results are presented of the study of the input devices of a linear accelerator. Theoretical design data obtained on an electronic computer are compared with experimental data obtained on an I-2 linear accelerator. The advantage of an active symmetric focusing system over quadrupole systems for high (above 500 mA) beam currents is demonstrated. Modernization of the focusing channel is described which allows the current at the output of the I-2 linear accelerator to be increased to 200 mA. (auth)

25303 DEVICE FOR ONE-TURN EXTRACTION OF AN ELECTRON BEAM FROM A HIGH-CURRENT BETATRON. Moskalev, V. A.; Shashov, V. V. (Tomsk Polytechnic Inst., USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 15: No. 6, 1636-1638(1972).

Translated from Prib. Tekh. Eksp.; 15: No. 6, 22-24(1972).

A system for extracting an electron beam from a high-current 25-MeV betatron is described, which allows electron-beam pulses to be obtained having duration of 5 to 6×10^{-9} s. The beam current of the pulse is 4.8 A. The range over which the maximum electron energy can be controlled is 3 to 25 MeV. The power-supply circuits of the extraction devices are presented, as well as the principal parameters of the extracted electron beam. (auth)

25304 SYSTEM FOR CONTROLLING THE CURRENT OF THE BEAM IN A LINEAR ELECTRON ACCELERATOR. Makhnenko, L. A.; Salii, L. D.; Skubko, V. A. (Physical-Technical Inst., Kharkov). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 15: No. 6, 1639-1641(1972).

Translated from Prib. Tekh. Eksp.; 15: No. 6, 24-26(1972).

A network for controlling the intensity of the beam in an electron accelerator in the range from 0 to 100% is considered in which a two-electrode gun with indirect heating of the cathode by an auxiliary electron beam is used. Control is achieved by varying the emission current of the heating gun. The fluctuations of the beam current do not exceed ±0.35%, while the control quantization is 10^{-4}. (auth)

25305 ACCELERATION OF LASER-PLASMA IONS IN A CYCLOTRON. Anan'in, O. B.; Bykovskii, Yu. A.; Kozyrev, Yu. P.; Tsybin, A. S. (Moscow Engineering Physics Inst.). JETP Lett. (USSR) (Engl. Transl.); 17: No. 9, 330-332(5 May 1973).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 17: No. 9, 460-463(5 May 1973).

Experiments aimed at registering multiply charged ions in a laser plasma and at investigating such ion-emission characteristics as the maximum ionization multiplicity, the energy and spatial distribution of the ions, and the number of ions of given charge, have shown that a laser plasma is an effective source of multiply charged ions (MCI) and can be used in accelerator injectors. The experimental realization of acceleration of D^+ ions of a laser plasma in a cyclotron is reported. Internal ion injection was used, i.e., the laser plasma was produced in a magnetic field of the cyclotron inside the accelerating gap. (WHK)

Ion Optics and Field Calculations

25306 (RL-73-59) 70-MeV INJECTOR MODIFICATIONS TO TANK 2 INPUT HALF DRIFT TUBE QUADRUPOLE. Elliott, R. T. (Rutherford High Energy Lab., Chilton (England)). 1973. 12p. Dep. NTIS (U. S. Sales Only) $3.00.

The requirements for Tank 2 input half drift quadrupole for the 70 MeV injector for NIMROD are stated. The existing design is examined and modifications necessary to meet the latest requirements are discussed under the headings of thermal improvements and magnetic improvements. (UK)

25307 (RL-73-60) 70-MeV INJECTOR EFFECTIVE LENGTHS OF DRIFT TUBE dc QUADRUPOLES. Elliott, R. T.; Flower, P. S. (Rutherford High Energy Lab., Chilton (England)). 1973. 12p. Dep. NTIS (U. S. Sales Only) $3.00.

Methods are presented for determining effective lengths of drift tube dc quadrupoles for the 70 MeV injector for NIMROD. (UK)

25308 (RL-73-80) GOOD FIELD REQUIREMENTS IN THE PROTON RING OF EPIC II/III. Maidment, J. R. (Rutherford High Energy Lab., Chilton (England)). Jul 1973. 8p. Dep. NTIS (U. S. Sales Only) $3.00.

In a previous note the good field requirements in the electron ring of EPIC II/III were detailed. In the present note the good fields necessary in the proton ring for e-p operation are derived. (UK)

25309 ELECTRON-OPTICAL PROPERTIES OF A SYSTEM FOR ROTATING AND DEFLECTING A LINE FOCUS. Gorelik, S. L.; Markovich, M. G.; Tsukkerman, I. I. Sov. Phys.-Tech. Phys. 17: No. 9, 1568-1572 (Mar 1973).

The electron-optical properties of a system for rotating and deflecting a line focus are considered. The main factors influencing the image quality are the focusing errors and the errors in the position of the center and of the angular orientation, which result from errors in the assembly and construction of the double quadrupole lens and also from the aberrations of the deflecting system. The methods developed for correcting the indicated errors make it possible to reduce their influence appreciably. (auth)

25310 NUMERICAL SIMULATION OF PARTICLE MOTION IN AN ACCELERATOR WITH ASYMMETRIC VARIABLE-PHASE FOCUSING. Dreval', I. D.; Kushin, V. V. Sov. Phys.-Tech. Phys. 17: No. 9, 1535-1539 (Mar 1973).

The available data on the characteristics of asymmetric variable-phase focusing (AVPF) are inadequate for estimating the effect of the relationship between phase and radial oscillations in capture in an accelerator with AVPF or the role of adiabatic damping of oscillations and their nonlinearity. These factors can be determined only by direct computer calculations of the phase and radial trajectories of particles in the accelerator. Such calculations are performed for protons in an accelerator with drift tubes for a wavelength of 2 m in the energy range 50 keV to 1 MeV. The choice of the unusually low injection energy is dictated by the possibility of subsequent experiment verification of the calculation results. The calculations are performed for a relatively wide range of values of the basic accelerator parameters near their optimum values, found by means of the combined stability diagram. Because of the limited length of the accelerator, the requirements that the phase spread less than $\pm$ (20-30°) and the velocity spread to be less than $\pm$ (1.0-2%) at the exit are used as the longitudinal stability criteria. The transverse stability criterion is defined by the requirement that the deviations of the particles from the accelerator axis be smaller than the aperture radius, which is assumed to be 5 mm. Special attention is paid to the effect of phase oscillations on radial oscillations. It is shown that this relation reduces appreciably the effective acceptance of the accelerator and increases considerably the effective beam emittance. It has been found that the capture reaches 70° with respect to phase and $\pm$3% with respect to the allowable velocity spread. The reduced effective acceptance is equal to 0.25π mrad.cm. The reduced effective emittance of the exit from the accelerator reaches 0.8π mrad.cm. Comparison of our results with the preliminary analytical estimates and with the results of numerical investigations of Good-Fainberg variable-phase focusing shows the advisability of introducing asymmetry in variable-phase focusing in order to improve capture in the accelerator. (auth)

Storage Rings

25311 (BNL-18092) MEASUREMENTS OF ADSORPTION ISOTHERMS AND PUMPING SPEED OF HELIUM ON MOLECULAR SIEVE IN 10^{-11} TO 10^{-7} TORR RANGE AT 4.2 K. Halama, H. J.; Aggus, J. R. (Brookhaven National Lab., Upton, N. Y.). 1973. 15p. (CONF-731006-1). Dep. NTIS $3.00.

We have extended the experimental data on helium adsorption isotherms for molecular sieve from 10^{-7} to 10^{-11} Torr. A commercially available cryopump CVR 1008 made by Excalibur was used for this investigation. It was found that, in general, the experimental points fall on a curve predicted by the Dubinin and Radushkevich theory down to 1×10^{-10} Torr. Below this pressure the slope gets steeper and possible causes for this behavior are being studied. When compared with bare copper surfaces, a 1.8-mm-thick layer of bonded molecular sieve 5A adsorbs almost 10^5 times more helium per unit area. The pumping speed remains high for leaks $Q < 1 \times 10^{-6}$ Torr liters/sec with coverages of 10 cm^3 (STP)/cm^2 adsorbent. Cryosorption looks very attractive for pumping large amounts of helium at low pressures and is therefore suitable for superconducting storage rings where the pumps have to operate inside superconducting magnet dewars. (auth)

25312 (BNL-18176) STANDARD PARAMETERS FOR ISA-BELLE DESIGN CALCULATIONS. Courant, E. D. (Brookhaven National Lab., Upton, N. Y.). 1 Aug 1973. 3p. Dep. NTIS $3.00.

To facilitate comparison between different calculations of ISA layout, lattice, radiofrequency, luminosity and other calculations it is desirable to base all of these on a standard set of assumptions concerning AGS parameters, transfer energy, and final energy. Otherwise confusion may arise, for example, if one calculation is based on transfer energy of 30 GeV and another on $\gamma = 30$. Values for universal constants and formulas, transfer and final energies, and AGS orbit and beam parameters are proposed for adoption in all ISA calculations. (WHK)

25313 (RL-73-70) BEAM SEPARATION IN THE EPIC II e^+-e^- OPTION. Maidment, J. R. (Rutherford High Energy Lab., Chilton (England)). Jul 1973. 5p. Dep. NTIS (U. S. Sales Only) $3.00.

The EPIC II conventional magnet ring (ESRI) has been described previously and the good field requirements have been derived. The present note describes one possible system of beam separation, using an electrostatic field, in the interaction region for the e^+-e^- option. The resulting consequences on the good field requirements are calculated. (UK)

25314 (RL-73-75) REFLECTIONS ON ERICE. Donald, M. H. R.; Lawson, J. D. (Rutherford High Energy Lab., Chilton (England)). Jul 1973. 5p. Dep. NTIS (U. S. Sales Only) $3.00.

A summary is presented of topics discussed at a Summer School on "High Intensity Relativistic Particle Beams" held at Erice on June 5 to 16, 1973. It is in two parts: a very brief statement of topics not relevant to the proposed storage ring EPIC; and a somewhat more detailed summary of the topics relevant to EPIC. The second part summarizes the discussions on general theory of instability, measurements in storage rings, and Arnol'd diffusion. Finally, the implications for EPIC of the subjects discussed at the School are reviewed. (UK)

25315 (RL-73-79) Q-SHIFTS AND Q-SPREADS ASSOCIATED WITH THE HEAD ON COLLISION OF BUNCHES OF UNEQUAL SIZE. Lawson, J. D. (Rutherford High Energy Lab., Chilton (England)). Jul 1973. 5p. Dep. NTIS (U. S. Sales Only) $3.00.

When bunches with unequal area collide, the degree of nonlinearity introduced into the orbit dynamics for a given linear Q shift is a function of the relative bunch areas. A very crude estimate of this effect is made, and it is shown that it might result in some reduction of luminosity for an e-p system with unequal beams. (auth)

25316 COLLIDING PROTON BEAMS AT CERN. Cocconi, G. (CERN, Geneva). pp 22-27 of 12th International Conference on Cosmic Rays. Hobart, Australia; International Union of Pure and Applied Physics (1971).

From 12th international conference on cosmic rays; Hobart, Australia (16 Aug 1971).

A summary is given of operational developments with CERN ISR. The experimental program is currently carried out with currents in each ring up to ~5 A, and with beam height ~0.5 cm the interaction rates are up to 2.10^4 s^{-1}. (AT)

Experimental Facilities

Refer also to abstract 24255.

25317 (ANL-8032) APPLICATIONS OF A PULSED SPALLATION NEUTRON SOURCE. Report of a Workshop Held at Argonne National Laboratory, April 29-May 4, 1973. (Argonne National Lab., ILL). 1973. Contract W-31-109-eng-38. 104p. Dep. NTIS $5.45.

A summary is presented of the conclusions reached by the participants of a workshop held to discuss the applications of a pulsed spallation neutron source. Reports are made from the six working groups devoted to (1) high-energy-transfer inelastic scattering, (2) low-energy-transfer inelastic scattering, (3) diffraction from single crystals, (4) diffraction from isotropic samples, (5) radiation effects and (6) prospects and problems. External reports on pulsed neutron radiography and on a neutron-neutron scattering experiment are included. (18 figures, 18 references) (auth)

For abstracts of individual papers see: 24255, 24546, 24933, 25319-25331, 26090, 26091, and 26532-26535.

25318 (EUR-4954) PULSED NEUTRONS AND THEIR UTILIZATION. Proceedings of the Joint Meeting, Ispra, September 17-18, 1971. (European Communities, Luxembourg.

Commission). Apr 1973. 510p. (CONF-710985-). EUR FB. 550-.

Separate abstracts were prepared for 22 of the 25 papers presented. The remaining 3 papers were not within the scope of NSA. (WHK)

25319 (EUR-4954, pp 3-8) GENERAL REMARKS ON THE LINAC-BOOSTER FACILITY PROJECTED IN JAPAN. Suita, T. (Osaka Univ.); Kimura, M. Apr 1973.

From joint meeting on pulsed neutrons and their utilization; Ispra, Italy (17 Sep 1971).

The study of linac-booster type pulsed neutron sources now going on in Japan is one of the items listed in the recommendations of the Japan Science Council to the Japanese Government to be acted on the coming five years. Many physicists and reactor engineers in universities and other establishments, such as the Japan Atomic Energy Research Institute (JAERI), are now in intimate collaboration for design study as well as for experimental research and developmental work on such sources. The organization and activities to promote the linac-booster project in Japan are described. (EU)

25320 (EUR-4954, pp 11-26) ASPECTS ON THE UTILIZATION OF THE PROPOSED PULSED NEUTRON FACILITY IN JAPAN. Kimura, M.; Ishikawa, Y.; Watanabe, N. (Tohoku Univ., Sendai). Apr 1973.

From joint meeting on pulsed neutrons and their utilization; Ispra, Italy (17 Sep 1971).

The linac-booster pulsed neutron facility now proposed by Japanese scientists has some special features to be discussed. Some aspects on the choice of the scale of the proposed facility are discussed, and reasons for a linac-booster instead of a pulsed reactor are presented. Experiences using the Tohoku University 300-MeV linac for the utilization of pulsed neutrons to estimate the potentiality of the future source are described briefly together with some other considerations on the usage of pulsed beams. Finally, utilization in some other fields of the pulsed neutrons is considered. (EU)

25321 (EUR-4954, pp 35-64) NEUTRON SPECTROSCOPY WITH LINAC-BOOSTER (PROJECTED IN JAPAN). Ishikawa, Y.; Kimura, M.; Watanabe, N. (Tohoku Univ., Sendai). Apr 1973.

From joint meeting on pulsed neutrons and their utilization; Ispra, Italy (17 Sep 1971).

The utilization of the linac-booster type pulsed neutron source for neutron scattering has been discussed in three different energy regions. In thermal neutron scattering, the merit of the pulsed neutron source would be found only either in high-resolution scattering experiments with large momentum transfers or in very conventional powder diffraction measurements. In the epithermal neutron region, the potentiality of the pulsed neutron source for paramagnetic scattering from itinerant electron systems has been examined by computer experiments. It has been found that the scattering would be observable with sufficient energy and momentum resolutions if the energy transfer is less than 0.5 eV. In the cold neutron region, a new method named "wave correlation chopper method" has been proposed to increase the efficiency of the measurements. (EU)

25322 (EUR-4954, pp 75-93) EXPERIENCE USING THE TOHOKU ELECTRON LINAC AS A PULSED NEUTRON SOURCE FOR THE STUDY OF CONDENSED MATTER. Kimura, M.; Kubota, T.; Niimura, N.; Oyamada, M.; Ozora, A.; Sato, K.; Takahashi, F.; Takeda; Tomiyoshi, S.; Yamada, Y.; Watanabe, N. (Tohoku Univ., Sendai). Apr 1973.

From joint meeting on pulsed neutrons and their utilization; Ispra, Italy (17 Sep 1971).

The Tohoku University electron linac can afford pulsed thermal neutron beams with the flux of 10^{12} $n_{th}/sec \cdot cm^2$ at the moderator surface with the pulse width of 20 ~ 40 μsec and with any repetition less than 300 pps. Debye–Scherrer analysis for magnetic and nonmagnetic materials, determination of structure factor for liquid metal, and the inverse filter method for hydrogeneous molecules were surveyed using TOF methods. It was also found that the single crystal can be analyzed efficiently, in contradiction to general expectations. (auth)

25323 (EUR-4954, pp 97-123) TECHNICAL ASPECTS CONCERNING THE LINAC-BOOSTER NEUTRON SOURCE PROPOSED IN JAPAN. Egusa, T. (Tohoku Univ., Sendai); Fuketa, T.; Hamaguchi, Y.; Hirata, M.; Izumi, T.; Kimura, M.; Moriyama, N.; Ohno, Y.; Ohtake, I.; Oyamada, M.; Suda, S.; Suita, T.; Sumita, K.; Wakabayashi, J.; Watanabe, N. Apr 1973.

From joint meeting on pulsed neutrons and their utilization; Ispra, Italy (17 Sep 1971).

In the proposed pulsed neutron facility, epithermal neutrons will be produced as well as cold and thermal neutrons. The electron linac and dynamic booster combination was adopted as the fundamental design. The basic principles and some details of the linac booster system as a pulsed neutron source are described. Electron acceleration, beam transport and neutron producing targets are discussed. Finally some rough configurational images of the facility, especially the booster and its surroundings are described. (EU)

25324 (EUR-4954, pp 127-136) CONCEPTUAL DESIGN STUDY OF THE ROTATING REFLECTOR FOR THE PROPOSED LINAC-BOOSTER FACILITY IN JAPAN. Kimura, M. (Tohoku Univ., Sendai); Egusa, T.; Watanabe, N.; Hirata, M.; Ohno, Y.; Sumita, K.; Nagashima, K.; Izumi, T.; Takahashi, J.; Iyoku, K. Apr 1973.

From joint meeting on pulsed neutrons and their utilization; Ispra, Italy (17 Sep 1971).

The rotating reflector designed for the proposed linac-booster facility in Japan is composed of a horizontal shaft and four arms made of Ti alloy, each holding a Be reflector block of 275 $mm^{\phi} \times 100$ mm^{t}. Strength calculations and cooling estimations are also made. Some points desirable for further research and development are listed, recommending also the mock-up test of the actual size. (EU)

25325 (EUR-4954, pp 139-149) NEUTRON TIME-OF-FLIGHT SPECTROMETRY FOR SINGLE CRYSTALS. Niimura, N.; Tomiyoshi, S.; Watanabe, N.; Kimura, M. (Tohoku Univ., Sendai). Apr 1973.

From joint meeting on pulsed neutrons and their utilization; Ispra, Italy (17 Sep 1971).

A standard procedure of analyzing single crystals is developed. It is shown, with some examples ($BaTiO_3$, KBr, $AuMn_{0.5}$) that some special problems for single crystals can be favorably investigated using the pulsed neutron source. (EU)

25326 (EUR-4954, pp 153-163) FEASIBILITY STUDY OF APPLYING NEUTRON T-O-F METHOD FOR THE LIQUID STRUCTURE ANALYSIS. Tomiyoshi, S.; Watanabe, N.; Misawa, M.; Kai, K.; Niimura, N.; Oyamada, M.; Kimura, M. (Tohoku Univ., Sendai). Apr 1973.

From joint meeting on pulsed neutrons and their utilization; Ispra, Italy (17 Sep 1971).

The preliminary study of applying time-of-flight neutron diffraction method for the determination of the structure factor of liquid metals has been examined. The diffraction pattern of liquid Sn at 260°C has been measured using a time-of-flight neutron diffractometer incorporated with an electron linear accelerator pulsed neutron source and a fairly good agreement between the present results and those of North et al. (1968) has been obtained. It was concluded that the TOF method incorporated with pulsed neutron source can yield reliable data for the liquid metal structure analyses which are as accurate as in the case of using steady reactor if some more improvement in measuring techniques were applied. (EU)

25327 (EUR-4954, pp 203-214) DYNAMICS OF LINAC-BOOSTER TYPE REPETITIVE PULSED NEUTRON SOURCE. Wakabayashi, J. (Kyoto Univ.). Apr 1973.

From joint meeting on pulsed neutrons and their utilization; Ispra, Italy (17 Sep 1971).

The space dependent neutron dynamics was calculated using the modal method and it was found that the higher modes are decreased rapidly compared with that of the pulse width. The operating characteristics are calculated using the one point kinetic equation and the following results were found: (1) the neutron flux due to the delayed neutron sources is about 10^{-4} of the peak flux, and (2) the internal feedback effects on the each single pulse operation are negligibly small. Finally, the several important items for the control of the linac booster are pointed out based on the results of numerical calculation. (EU)

25328 (EUR-4954, pp 217-229) BEAM TRANSPORT SYSTEM IN THE LINAC-BOOSTER FACILITY. Oyamada, Y. (Tohoku Univ., Sendai); Watanabe, N.; Kimura, M.; Fuketa, T. Apr 1973.

From joint meeting on pulsed neutrons and their utilization; Ispra, Italy (17 Sep 1971).

The coupling between linac and the booster core may be one of the difficult and most important problems in the design of the proposed linac facility. The beam characteristic was assumed to be the same as those for the conventional linac. A MQM achromatic beam deflection system was assumed and the beam trajectory was calculated. Safe injection of the electron beam into the target can be anticipated as long as the momentum shift of the electrons is less than ±10%. (EU)

25329 (EUR-4954, pp 233-236) CONTROL SYSTEM FOR NEUTRON PRODUCTION IN THE PROPOSED LB FACILITY. Sumita, K.; Suda, N. (Osaka Univ.). Apr 1973.

From joint meeting on pulsed neutrons and their utilization; Ispra, Italy (17 Sep 1971).

Some considerations on the control system for the neutron output from the linac booster neutron source are presented. The mechanical control of the rotating reflector is left undiscussed together with the individual components of the facility. (EU)

25330 (EUR-4954, pp 239-251) SPATIAL DISTRIBUTION OF NEUTRONS IN A LEAD ASSEMBLY PRODUCED BY A 200-MeV ELECTRON BEAM BOMBARDMENT. Yano, T.; Yamazaki, Y.; Egusa, T.; Watanabe, N.; Oyamada, M.; Kimura, M. (Tohoku Univ., Sendai). Apr 1973.

From joint meeting on pulsed neutrons and their utilization; Ispra, Italy (17 Sep 1971).

Preliminary measurements of the spatial distribution of photoneutron yield in the electron-photon cascades in lead by 200 MeV electrons have been carried out to offer some fundamental data on the design of the linac-booster system. These data are compared with the results of the energy loss distribution measured by Murata (J. Phys. Soc. Japan 20: 209 (1965)). (EU)

25331 (EUR-4954, pp 255-284) MODERATOR OPTIMIZATION STUDIES FOR ACCELERATOR PULSED BOOSTER. Watanabe, N.; Kimura, M.; Takahashi, H.; Tomiyoshi, S. (Tohoku Univ., Sendai). Apr 1973.

From joint meeting on pulsed neutrons and their utilization; Ispra, Italy (17 Sep 1971).

Preliminary studies on moderator optimization for a pulsed thermal neutron source for time-of-flight experiments have been carried out using a neutron diffraction spectrometer with an electron linear accelerator. The present experiment was designed to obtain the basic parameters for determining the pulse characteristics of thermal neutrons and to find moderators suitable to the short pulse of fast neutrons such as from the accelerator pulsed booster. The moderators investigated were pure and homogeneously poisoned light water at equilibrium temperature, pure and heterogeneously poisoned polyethylene slabs at equilibrium and liquid nitrogen temperature and pure and heterogeneously poisoned solid ammonia at liquid nitrogen temperature. Their pulse characteristics such as peak intensity, full width at half maximum, full width at $1/_5$ maximum etc. were measured as a function of slab thickness, homogeneous poison concentration and geometrical parameters of heterogeneous poisoning. Figures of merit were obtained for various moderators. (EU)

25332 (INP-826) SIMPLE STABILIZER OF HIGH VOLTAGE SUPPLY FOR A FAST NEUTRON GENERATOR. Kliczewski, S.; Lewandowski, Z. (Institute of Nuclear Physics, Krakow (Poland)). Jan 1973. 13p. Dep. NTIS (U.S. Sales Only) $3.00.

An efficient stabilizer circuit for a 240 kV high voltage supply for a T(d,n) or D(d,n) fast neutron generator is described. It has two separate feedback loops and its construction is based on semiconductor components. (auth)

25333 (KFK-1763) ECONOMIC STUDIES OF SUPERCONDUCTING MAGNETS AND THEIR REFRIGERATION FOR THE CERN II NORTH EXPERIMENTAL AREA. Green, M. A. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Experimentelle Kernphysik). Jun 1973. 27p. Dep. NTIS (U. S. Sales Only) $3.50.

Experimental areas for large proton-synchrotrons may be designed by using either normally conducting or superconducting magnets. The superconducting alternative is studied for both primary and secondary beams in the proposed North Experimental Area of the CERN 300-GeV synchrotron. The requirements for helium refrigeration systems are specified in both cases. The refrigeration for the secondary beams may be quite different from the one used in the beam line magnets. Cost estimates are given for the refrigeration system and the magnets themselves in independence on field level and magnet aperture. (GE)

25334 LARGE ACCEPTANCE PION CHANNEL FOR CANCER THERAPY. Boyd, D.; Schwettman, H. A.; Simpson, J. (Stanford Univ., CA). Nucl. Instrum. Methods; 111: No. 2, 315-331(1973).

The design of a large acceptance superconducting toroidal pion channel with solid angle greater than 1 sr and momentum acceptance of several percent is presented. Measurements of characteristics of negative pion production with an electron beam including thick target cross sections, electron and muon beam contaminants, and neutron and gamma ray backgrounds are described. These parameters are used to define a pion channel configuration with desirable properties for use in the radiation therapy of cancer. The method of computer design of the magnetic fields and calculation of pion trajectories is discussed along with a description of momentum and spatial resolution effects. Further discussion is included with respect to the specific engineering design problems of the winding configuration, cryogenic system, radiation damage, and the multiple momentum defining slit system. (auth)

25335 UNIVERSAL SCATTERING CHAMBER WITH REMOTE CONTROL. Andreev, G. B.; Borovlev, V. I.; Koloberdyan, V. E.; Lopatko, I. D.; Slabospitskii, R. P.; Chekanov, S. Ya. (Physicotechnical Inst., Kharkov). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 1, 58-60(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 1, 56-58(1973).

A universal remotely controlled scattering chamber for nuclear research is described. The chamber may be used in experiments with polarized and unpolarized beams on solid and gas targets with recording of both charged particles and the γ-quanta. The construction of the chamber allows remote variation of the angles of the semiconductor detectors without breaking the vacuum, performance of experiments on double scattering, and fabrication of the target in a vacuum directly in the working cavity of the chamber. The chamber is equipped with a cassette for seven solid targets and a device for accommodating two gas targets. The required target is mounted remotely on command of the experimenter. (auth)

25336 SCANNING A BEAM OF IONS THAT HAVE BEEN ACCELERATED IN A CYCLOTRON. Gusinskii, G. M.; Ivantsov, L. F.; Lemberg, I. K. (Physicotechnical Inst., Leningrad). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 1, 24-27(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 1, 27-30(1973).

A device is described that uses shunting of the windings of a quadrupole magnetic lens in order to scan a beam of accelerated ions that have been extracted from a cyclotron. The scanning range is 9 to 180 Hz. The device is used in performing activation analysis of biological objects in order to reduce the errors associated with nonuniform target thickness. (auth)

25337 INSTALLATION FOR OBTAINING A JET TARGET WHICH OPERATES FROM THE INTERNAL BEAM OF AN ACCELERATOR. Bartenev, V. D.; Beluchkina, A. A.; Valevich, A. I.; Gai, V. I.; Gorelov, A. M.; Ershov, V. P.; Kotova, L. S.; Nikitin, V. A.; Pilipenko, Y. K.; Smelyanskii, V. V. (Joint Inst. of Nuclear Research, Dubna, USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 1, 28-31(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 1, 30-33(1973).

The construction of an installation for operation on the internal beam of an accelerator is described. The processes of obtaining jets of condensed hydrogen in a vacuum were investigated. All of the described measurements were carried out on the test bench. (auth)

25338 PROTON GENERATOR. Surenyants, V. V.; Sidorov, I. T.; Davydov, A. T. Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 1, 14-17(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 1, 19-21(1973).

A proton generator is proposed (proton energy ~ MeV) which uses the $^3He(d,p)^4He$ reaction. Unlike well-known evacuated installations which operate on the basis of the $D(^3He,p)^4He$ reaction, this instrument is sealed. The procedure for registering ^3He in the generator target is described. The calculated number of protons for a deuteron current of 10^{-6}°C, an energy of 170 keV, and $\tau_{pul} = 10^{-6}$ sec amounts to 5×10^4 protons/pulse. The useful portion of the protons extracted through a special thin-walled window amounted to 0.5×10^3 protons/pulse. It is shown that the proton yield may be increased substantially by increasing the accelerating voltage. (auth)

25339 ELECTROSTATIC SEPARATOR WITH A SEMICONDUCTOR CATHODE AND SOFT ELECTRIC AND MAGNETIC FIELDS. Ergakov, V. A.; Kryuchkov, I. I.; Korolev, V. A.; Lapikov, V. A.; Trebukhovskii, Yu. V.; Khar'yuzov, V. A.; Cheban, G. A. (Inst. of Theoretical and Experimental Physics, Moscow). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 15: No. 6, 1655-1658 (1972).

Translated from Prib. Tekh. Eksp.; 15: No. 6, 36-39(1972).

The characteristics of an electrostatic separator with crossed electric and magnetic fields and a cathode made of semiconductor glass with a bulk resistivity $\rho_v = 1 \cdot 10^7$ to $3.5 \cdot 10^{10}$ $\Omega \cdot$ cm were investigated. A separator having an electrode area 11,500 cm^2 and a distance between electrodes equal to 4 cm was used to obtain the electric field E = 100 kV/cm for a magnetic field intensity H = 300 Oe. (auth)

25340 UNIVERSAL LIQUID-HYDROGEN TARGET FOR EXPERIMENTS WITH HIGH-ENERGY PARTICLES. Vasil'ev, L. M.; Dmitrevskii, Yu. P.; Kashtanov, E. M.; Mel'nik, Yu. M. Instrum. Exp. Tech. (USSR) (Engl. Transl.); 15: No. 6, 1648-1651(1972).

Translated from Prib. Tekh. Eksp.; 15: No. 6, 30-33(1972).

The construction and characteristics of a liquid-hydrogen target used in experiments on the measurement of charge-exchange cross sections of pions on the accelerator of the Institute of High-Energy Physics are described. The construction allows the lavsan

targets to be changed, and likewise permits the portion of the target situated under the beam to be changed in accordance with the requirements of the experiment, and the heat shielding of the target to be modified. (auth)

25341 HELIUM-II CRYOSTAT FOR A SUPERCONDUCTING PARTICLE SEPARATOR. Ruppert, K. (Linde AG, Munich). pp 108-110 of Proceedings of the Fourth International Cryogenic Engineering Conference. Guildford, Eng.; IPC Science and Technology Press Ltd. (1972).

From 4th international cryogenic engineering conference; Eindhoven, Netherlands (24 May 1972). See CONF-720565-.

A cryostat has been developed for testing superconducting high-frequency particle separators operating at 1.8°K. The cryostat has a length of 4 m and permits, by means of flange connections, the handling of separator structures up to a length of 3 m. The essential characteristics of the cryostat, the construction and manufacturing of which are subject to special demands are described. Measurements have shown that the demands on the cryostat at 1.8°K as regards tightness, adjustability and maximum deflection of the separator structure are fulfilled. (auth)

25342 SUPERCRITICALLY COOLED SUPERCONDUCTING MUON CHANNEL. Vecsey, G. (Swiss Inst. for Nuclear Research, Zurich). pp 230-232 of Proceedings of the Fourth International Cryogenic Engineering Conference. Guildford, Eng.; IPC Science and Technology Press Ltd. (1972).

From 4th international cryogenic engineering conference; Eindhoven, Netherlands (24 May 1972). See CONF-720565-.

The conventional injection system of the SIN muon channel collects part of the pions produced in the target in the 500-MeV proton beam of the meson factory. They are guided on their decay path by a superconducting solenoid. After spiralling along the axial field lines along the channel the muons can be stopped in an internal target or can leave the channel and hit an external target. Together with beam dynamical calculations different possibilities of realisation of the superconducting part were considered in 1969. In 1970 development was commenced of a test section based on a new concept, combining the advantages of intrinsically stable conductors (high current density) with those of supercritical cooling (closed circuit, easier and lighter construction, structural flexibility). The main design principles and first test results are given. (auth)

PHYSICS (ASTROPHYSICS AND COSMOLOGY)

Cosmic Radiation

Refer also to abstracts 25547 and 25741.

25343 (AD-759414) COSMIC-RAY GENERATION BY PULSARS. Kennel, C. F.; Schmidt, G.; Wilcox, T. (California Univ., Los Angeles. Plasma Physics Group). Apr 1973. Contract N00014-69-A-0200-4023. 17p. (PPG-144). NTIS.

Electromagnetic and particle energy fluxes are equipartitioned in a superrelativistic plasma wave. The consequences for cosmic-ray acceleration by pulsars are investigated. (auth) (NTIS)

25344 (AECL-4354) COSMIC RAY NM-64 NEUTRON MONITOR DATA. XXII. Monthly Graphs, May–August 1972. Steljes, J. F. (Atomic Energy of Canada Ltd., Chalk River (Ontario). Chalk River Nuclear Labs.). May 1973. 86p. Dep. NTIS (U. S. Sales Only) $6.50. AECL $2.00.

Uncorrected and barometer-corrected results from the cosmic-ray stations in Canada using equipment maintained by AECL are given in tabular form for the period from May to August 1972. Normalized graphs are given for the same period. Correction factors for the constant rates of drift of the barometers at each of the four stations are given. Detailed listings of the event of August 3–10 are included. (auth)

25345 (AECL-4594) COSMIC RAY NM-64 NEUTRON MONITOR DATA. XXIII. Monthly Graphs, September–December 1972. Steljes, J. F. (Atomic Energy of Canada Ltd., Chalk River (Ontario). Chalk River Nuclear Labs.). Jun 1973. 64p. Dep. NTIS (U.S. Sales Only) $5.25. AECL $1.50.

Uncorrected and barometer-corrected results from the cosmic-ray stations in Canada using equipment maintained by AECL are given in tabular form for the period from September to December 1972. Normalized graphs are given for the same period. (auth)

25346 12th INTERNATIONAL CONFERENCE ON COSMIC RAYS. Conference Held at Hobart, Australia, August 16–25, 1971. Hobart, Australia; International Union of Pure and Applied Physics (1971). 487p.

Separate abstracts were prepared for the 24 invited and rapporteur papers. (WDM)

For abstracts of individual papers see: 25316, 25347–25361, 25439, 25440, 25510–25512, and 25545–25547.

25347 SOME PROBLEMS OF THE THEORY OF THE ORIGIN OF COSMIC RAYS. Ginzburg, V. L.; Syrovatskii, S. I. (Lebedev Inst. of Physics, Moscow). pp 53-71 of 12th International Conference on Cosmic Rays. Hobart, Australia; International Union of Pure and Applied Physics (1971).

From 12th international conference on cosmic rays; Hobart, Australia (16 Aug 1971).

Attention is currently focussed on the trapping region and the characteristic exit time of cosmic rays from the Local Galaxy; the sources of cosmic radiation, particularly the role played by pulsars; and metagalactic cosmic radiation. Exit time is closely connected with the study of spectra of electron and positron components as well as chemical composition of cosmic rays. Electron studies are important because the intensity and spectrum of relativistic electrons in remote regions of space can be evaluated; and all positrons are secondary, making possible the calculation of the positron spectrum from the proton-nuclear component. Models derived from chemical composition studies are discussed, and consideration is given to the contribution in various energy regions, particularly $E \gtrsim 10^{17}$ eV of metagalactic rays. (AT)

25348 CURRENT STATUS OF THE QUARK HUNT. Jones, L. W. (Univ. of Michigan, Ann Arbor). pp 125-144 of 12th International Conference on Cosmic Rays. Hobart, Australia; International Union of Pure and Applied Physics (1971).

From 12th international conference on cosmic rays; Hobart, Australia (16 Aug 1971).

An analysis is made of cosmic ray and accelerator search programs for quarks with brief mention of tachyons. Reported positive results in general are considered to be less substantive than reported negative results. A list of searches in progress is given. (AT)

25349 RADIO EMISSION FROM EXTENSIVE AIR SHOWERS. Allan, H. R. (Imperial Coll. of Science and Tech., London). pp 161-173 of 12th International Conference on Cosmic Rays. Hobart, Australia; International Union of Pure and Applied Physics (1971).

From 12th international conference on cosmic rays; Hobart, Australia (16 Aug 1971).

Aspects of EAS are reviewed under the headings: the search for radio emission from showers; basic theory of the emission process; lateral spread of radiation about the shower axis; dependence of emission on height of shower maximum; determination of mass of EAS primaries; and range of primary energies for useful signals. (AT)

25350 HIGH ENERGY COSMIC RAY MUONS. Menon, M. G. K. (Tata Inst. of Fundamental Research, Bombay). pp 174-203 of 12th International Conference on Cosmic Rays. Hobart, Australia; International Union of Pure and Applied Physics (1971).

From 12th international conference on cosmic rays; Hobart, Australia (16 Aug 1971).

A status report on high-energy cosmic-ray muons is made based on papers presented at the conference. Known and hypothesized μ-production processes are described and experimental work in progress is analyzed within the following categories: (1) cosmic-ray neutrino experiments; (2) muon experiments (a-absolute muon spectrum at sea level; b-muon spectra and charge ratio; c-muon interactions; d-burst measurements; e-horizontal air showers; f-magnetic spectrographs; g-stopping particles underground); and (3) "sec-θ" effect on the processes responsible for high energy muons. (AT)

25351 PRIMARY COSMIC RAY ELECTRONS. Meyer, P. (Univ. of Chicago). pp 235-253 of 12th International Conference on Cosmic Rays. Hobart, Australia; International Union of Pure and Applied Physics (1971).

From 12th international conference on cosmic rays; Hobart, Australia (16 Aug 1971).

An analysis of the conference papers on this topic is given in the categories: solar electron emission; interplanetary phenomena and solar modulation; and the role of high-energy electrons in the Galaxy. Energy spectra are compared through the keV, MeV, and GeV ranges and the influence of 11 y solar cycle modulation, quiet time intensity changes of low-energy electrons, and Forbush decreases are discussed in the light of papers presented and the state of the art. (AT)

25352 EXTENSIVE AIR SHOWERS. McCusker, C. B. A. (Univ. of Sydney). pp 254-265 of Hobart, Australia; International Union of Pure and Applied Physics (1971).

From 12th international conference on cosmic rays; Hobart, Australia (16 Aug 1971).

A review of programs on EAS is made together with an analysis of papers presented at the conference, with particular reference to energy spectra. (AT)

25353 TRANSIENT SOLAR MODULATION OF COSMIC RAYS. Somogyi, A. J. (Central Research Inst. of Physics, Budapest). pp 268-284 of 12th International Conference on Cosmic Rays. Hobart, Australia; International Union of Pure and Applied Physics (1971).

From 12th international conference on cosmic rays; Hobart, Australia (16 Aug 1971).

A summary and analysis are made of the conference papers dealing with problems of Forbush decreases and cosmic-ray storms, or cosmic-ray intensity variations due to large-scale quasi-persistent azimuthal asymmetry particularly the 27 d variation in the solar wind. In almost all cases when the equilibrium of interplanetary space is disturbed, a marked gradient perpendicular to the ecliptic plane is produced. There is some evidence that this applies not only to shock waves, but also to weak perturbations like those producing the 27 d wave. (AT)

25354 HIGH ENERGY INTERACTIONS BELOW APPROX. 5 TeV. Sitte, K. (Univ., Frieburg i. B.). pp 285-307 of 12th International Conference on Cosmic Rays. Hobart, Australia; International Union of Pure and Applied Physics (1971).

From 12th international conference on cosmic rays; Hobart, Australia (16 Aug 1971).

Developments in the study of high-energy interactions using cosmic rays, particularly with respect to papers presented at the conference, are reviewed. Techniques and procedures, new data on bulk properties, and models and theories are analyzed. The role of interaction research using cosmic rays is examined in the light of high-energy colliding beam developments. (AT)

25355 HIGH ENERGY INTERACTIONS ABOVE APPROX. 5 TeV. Dobrotin, N. (Inst. of Physics, Moscow). pp 308-323

of 12th International Conference on Cosmic Rays. Hobart, Australia; International Union of Pure and Applied Physics (1971).

From 12th international conference on cosmic rays; Hobart, Australia (16 Aug 1971).

Light, heavy, and super heavy fireball models are considered in the light of experimental developments presented at the conference. Other aspects reviewed are the dependence of inelastic interaction cross section on energy, data from EAS studies, and new heavy particles. (AT)

25356 GALACTIC SOURCES AND THE PROPAGATION OF COSMIC RAYS. A Review of the Light Isotopes and the Odd-Z Elements. Simpson, J. A. (Univ. of Chicago). pp 324-356 of 12th International Conference on Cosmic Rays. Hobart, Australia; International Union of Pure and Applied Physics (1971).

From 12th international conference on cosmic rays; Hobart, Australia (16 Aug 1971).

The acceleration mechanisms involved in the nuclear component of primary cosmic radiation and the nucleosynthesis of the accelerated matter are considered. (WDM)

25357 STEADY-STATE SOLAR MODULATION OF COSMIC RAYS. Gleeson, L. J. (Monash Univ., Clayton, Australia). pp 357-378 of 12th International Conference on Cosmic Rays. Hobart, Australia; International Union of Pure and Applied Physics (1971).

From 12th international conference on cosmic rays; Hobart, Australia (16 Aug 1971).

A summary and evaluation are given of the papers on steady-state and quasi steady-state modulation presented at the Conference. An attempt is made to understand the observations, to construct models which reproduce these observations quantitatively, and, if possible, to work backwards from the observations, through the models, to obtain information about the interplanetary and interstellar regions. (WDM)

25358 SIDEREAL ANISOTROPY OF COSMIC RAYS. Sekido, Y. (Nagoya Univ., Japan). pp 379-392 of 12th International Conference on Cosmic Rays. Hobart, Australia; International Union of Pure and Applied Physics (1971).

From 12th international conference on cosmic rays; Hobart, Australia (16 Aug 1971).

The medium energy region, i.e., observations of muons underground or at large zenith angles, is considered. The present situation of accumulated data, i.e., the reports of the observed first and second sidereal harmonics averaged in one or a few years, is discussed. (WDM)

25359 GEOMAGNETIC EFFECTS ON COSMIC RAYS. Gall, R. (Univ. Nacional Autonoma de Mexico, Mexico City). pp 393-421 of 12th International Conference on Cosmic Rays. Hobart, Australia; International Union of Pure and Applied Physics (1971).

From 12th international conference on cosmic rays; Hobart, Australia (16 Aug 1971).

The geomagnetic effects are, by definition, the effects that the geomagnetic field exerts within its domain on the propagation of cosmic rays. A report is given on the contribution of the 12th International Conference on Cosmic Rays to the study of geomagnetic effects from a perspective of the development of this field within the last few years. (WDM)

25360 COMPOSITION OF COSMIC RAY NUCLEI, $Z \leq 26$. Shapiro, M. M. (Naval Research Lab., Washington, DC). pp 422-452 of 12th International Conference on Cosmic Rays. Hobart, Australia; International Union of Pure and Applied Physics (1971).

From 12th international conference on cosmic rays; Hobart, Australia (16 Aug 1971).

Elements up to nickel are considered in this review of the papers presented at the 12th International Conference on Cosmic Rays. (WDM)

25361 ULTRA-HEAVY COSMIC RAYS. Price, P. B. (Univ. of California, Berkeley). pp 453-473 of 12th International Conference on Cosmic Rays. Hobart, Australia; International Union of Pure and Applied Physics (1971).

From 12th international conference on cosmic rays; Hobart, Australia (16 Aug 1971).

The occurrence of trans-iron nuclei in primary cosmic radiation is reviewed. (WDM)

25362 STUDY ON COSMIC RAY MUONS ABOVE 10^{13} eV BY OBSERVATION OF HORIZONTAL AIR SHOWERS. Boehm, E.; Nagano, M. (Univ., Kiel). J. Phys., A (London); 6: No. 8, 1261-1284(Aug 1973).

The study of horizontal air showers (HAS) has been continued at Kiel with improved resolution in zenith angle determination. The zenith angle distribution of HAS is consistent with the sec θ distribution of muons in the size region between 2.5×10^3 and 3.1×10^4. The integral size spectrum is $I(\geq N, \geq 70°) = (1.3 \pm 0.4) \times 10^{-13}(N/10^4)^{-2 \cdot 4 \pm 0 \cdot 2}$ cm^{-2}s^{-1}sr^{-1} and is in agreement with the spectrum produced by muon bremsstrahlung as calculated by Kiraly, et al. (J. Phys. A. Gen. Phys.; 4: 367-76(1971)) up to the shower size of 5×10^4 within the experimental uncertainties. These results can be explained with the conventional model of muon production through pion decay (and to some extent through kaon decay) up to a muon energy of about 5×10^{13} eV. The number of muons observed in HAS is one order of magnitude larger than would be expected from the above bremsstrahlung hypothesis. The possibility of these muons being produced in HAS is discussed and methods of discrimination of remnant muons produced in EAS are presented. The upper limit of the flux of an isotropic component of muons or of heavy mass particles is discussed. (auth)

25363 GALACTIC COSMIC RAYS IN INTERPLANETARY SPACE. Leer, E. (Univ. of California, San Diego, La Jolla). Phys. Norv.; 6: No. 3-4, 193-198(1972).

Cosmic particles of galactic origin reach the orbit of the Earth. The low-energy particles, guided by the interplanetary magnetic field, all come from the polar regions. Particles with energies in $E \gtrsim 200$ GeV reaching a station on Earth with a vertical velocity at different local times come from different directions in the sky. Hence, an anisotropy in the distribution of galactic cosmic rays in interstellar space could be observable in this energy range. (auth)

25364 VARIABILITY OF THE ^{3}He AND ^{21}Ne PRODUCTION RATES IN ORDINARY CHONDRITES. Herzog, G. F. Geochim. Cosmochim. Acta; 37: No. 9, 2125-2133(Sep 1973).

^{26}Al and noble gas contents of 6 ordinary chondrites with ^{3}He/^{21}Ne ratios above 6.0 or below 4.0 are used to infer the variability of the production rates of ^{3}He and ^{21}Ne ($P(^3He)$ and $P(^{21}Ne)$). The ratio of the observed ^{26}Al content to a calculated, normal value is taken as a measure of the change of $P(^{21}Ne)$ from its normal value. The corresponding change in $P(^3He)$ is then computed from the observed ^{3}He/^{21}Ne ratio and an average value of $P(^3He)$. According to these calculations which exclude orbital effects, $P(^3He)$ will be near the average value in meteorites with high ^{3}He/^{21}Ne ratios, while $P(^{21}Ne)$ will be about 30% below normal. In meteorites with low ^{3}He/^{21}Ne ratios, $P(^3He)$ may be depressed by as much as 25% from normal while $P(^{21}Ne)$ may be 15 to 20% above the average. (auth)

25365 OPTICAL CHERENKOV EMISSION FROM LARGE COSMIC RAY AIR SHOWERS. Smith, G. J.; Turver, K. E. (Univ. of Durham, Eng.). J. Phys., A (London); 6: No. 8, L121-L126(Aug 1973).

Computer simulations of the optical Cherenkov emission from large cosmic-ray showers indicate that the form of the lateral distribution of photons is sensitive to the longitudinal development of the electron cascade and so to the nature of the primary particle. The breadth of the computed distribution of photons, confirmed by measurements made at the Haverah Park air shower array, suggest the possibility of detection of the largest air showers using widely separated, simple detectors. (auth)

25366 EARLY IRRADIATION OF MATTER IN THE SOLAR SYSTEM. Begemann, F. (Max-Planck-Institut fuer Chemie, Mainz). pp 250-256 of Origin of the Solar System. Reeves, H. (ed.). Paris; Centre National de la Recherche Scientifique (1972).

From symposium on the origin of the solar system; Nice, France (3 Apr 1972).

The study of cosmic-ray induced transmutations in meteorites demonstrated that during the past two billion years the intensity of the cosmic radiation has stayed essentially constant and that different meteorites have been exposed to cosmic radiation for different periods of time (cosmic-ray exposure ages). In addition, some of the meteoritic matter must have been irradiated prior to the time of compaction although it is not clear at present when this early irradiation occurred. The evidence for this early irradiation is summarized. (FR)

25367 DISTRIBUTION OF Ni, Ga, Ge, AND Ir BETWEEN METAL AND SILICATE PORTIONS OF H-GROUP CHONDRITES. Chou, C. L.; Baedecker, P. A.; Wasson, J. T. (Univ. of California, Los Angeles). Geochim. Cosmochim. Acta; 37: No. 9, 2159-2171(Sep 1973).

Concentrations of Ni, Ga, Ge, and Ir have been determined in the metal and silicate portions of 21 chondrites, including 15 H chondrites. The H-group metal shows the following concentration ranges: 7.2 to 9.4% Ni, 2 $\mathcal{A}$ to 18 ppM Ga, 61 to 70 ppM Ge, and 1.6 to 4.6 ppM Ir, and concentrations in H-group silicates are 94 to 380 ppM Ni, 3.0 to 9.2 ppM Ga, 0.06 to 0.66 ppM Ge, and 0.03 to 0.12 ppM Ir. The Ni, Ge, and Ir contents in the metal are positively correlated with each other and with the Fe content of olivine, as

expected from oxidation–reduction or combined metal–silicate-fractionation/oxidation–reduction models. Metal/silicate concentration ratios for Ir are lower than for Ge and Ni, despite the fact that Ir is more easily reduced to the elemental form. This may indicate that at the formation location of the H-group chondrites in the solar nebula, substantial amounts of Ir were present in condensed form at temperatures which were so high that Fe and Ni were present mainly as vapor. The metal/silicate concentration ratios of Ga and Ge are lower in type-3 ordinary chondrites than in types 4–6. Apparently appreciable fractions of these elements condensed from the nebula in oxidized form and entered the metal during later thermal events. That Ga and Ge were redistributed during recrystallization, whereas appreciable Ir remained in the silicate fraction, probably indicates that Ir faced a substantially greater diffusional barrier than did Ga and Ge. (auth)

25368 CHROMIUM AND PHOSPHORUS ENRICHMENT IN THE METAL OF TYPE 2 (C2) CARBONACEOUS CHONDRITES. Olsen, E. (Field Museum of Natural History, Chicago); Fuchs, L. H.; Forbes, W. C. (Field Museum of Natural History, Chicago). Geochim. Cosmochim. Acta; 37: No. 9, 2037-2042 (Sep 1973).

Electron microprobe analyses of metal grains in nine C2 meteorites show consistently high Cr and P contents, with large grain to grain variations within individual meteorites. Cr ranges from 0.16 to 1.0 wt % (average 0.6% for 43 analyses). P ranges from 0.00 to 3.2 wt % (average 0.42%). In addition, metal grains in seven C3 meteorites show a lesser enrichment of Cr, 0.00 to 0.7% (average 0.13% for 59 analyses), with no P present. Both of these elements, Cr and P, are generally below detection in the metal of other chondrite groups, equilibrated and unequilibrated. C2 metal grains occur typically as spherical to ovate blebs contained within single, euhedral forsterite crystals or crystal fragments that are either isolated in the black C2 matrix or are in clusters making up white inclusions. Metal is rare within true chondrules. Calculations of the expected Cr contents in metal condensing directly from a solar nebular gas agree remarkably well with the observed values. Unfortunately, no calculation is possible for P because of insufficient data at the present time. The composition and the textural relationships indicate this Cr, P rich metal, and the enclosing forsterite are direct condensates from a cooling solar nebula. Cr and P, in the quantities reported here, characterize C2 metal. (auth)

25369 TRAPPED SOLAR WIND NOBLE GASES AND EXPOSURE AGE OF LUNA 16 LUNAR FINES. Groegler, O. E.; Mendia, M. D.; Eberhardt, P.; Geiss, J. (Univ., Bern). Geochim. Cosmochim. Acta; 37: No. 9, 1991-2003 (Sep 1973).

He, Ne, Ar, Kr, and Xe concentrations and isotopic abundances were measured in three bulk grain size fractions prepared from sample L-16-19, No. 120 (C level, 20 to 22 cm depth) returned by the Luna 16 mission. The expected anticorrelation between the concentrations of trapped solar-wind noble gases and grain size is observed. Elemental abundances of solar-wind trapped noble gases are similar to those previously found in corresponding grain size fractions of the Apollo 11 and 12 fines. The trapped ratio $^4He/^{20}Ne$ varies in the soils from different lunar maria due to diffusion losses. A rough correlation of $^4He/^{20}Ne$ with the proportion of ilmenite in these samples is apparent. The elemental and isotopic ratios of the surface correlated noble gases in Luna 16 resemble those previously found in Apollo fines. Based on ^{21}Ne, ^{78}Kr, and ^{128}Xe a cosmic-ray exposure age of 360 my was determined. This age is similar to those obtained for the soils from other lunar maria. (auth)

25370 LOW-ENERGY COSMIC-RAY MUON FLUXES UNDERGROUND. Bhat, P. N.; Ramana Murthy, P. V. (Tata Inst. of Fundamental Research, Bombay). Lett. Nuovo Cim.; 7: No. 16, 830-832 (18 Aug 1973).

Observations of cosmic muon fluxes made at a depth of 985 Hg cm^{-2} below the top of the atmosphere are reported, and their implications are discussed in terms of the various processes of production of slow muons at deeper levels underground. (LBS)

25371 CHARGE AND ENERGY SPECTRA OF TRANS-IRON COSMIC RAYS. Shirk, E. K.; Price, P. B.; Kobetich, E. J. (Department of Physics, University of California, Berkeley, California 94720); Osborne, W. Z.; Pinsky, L. S.; (and others). Phys. Rev. D 7: No. 11, 3220-3233 (1 June 1973).

A 22-m^2 detector array consisting of G-5 nuclear emulsion, fast-film Čerenkov detector, and 40 sheets of plastic detectors was exposed for $\sim$ 60 h at a mean atmospheric depth of $\sim$ 3.7 g/cm^2 and a rigidity of < 2.5 GV. The detector was designed to determine both the charge and energy of trans-iron nuclei. For the first time it has been possible to determine cosmic-ray abundances in the difficult region $30 < Z \leq 42$ as well as to study the heavier nuclei. Over the entire periodic table from Ne on, the trend of cosmic-ray abundances is similar to that expected from sources with solar abundances, after nuclear reactions in interstellar space have been taken into account. The abundance ratios [$Z \geq 90$]:[$81 \leq Z \leq 83$]:[$74 \leq Z \leq 80$] are not inconsistent with solar abundances if Grevesse's photospheric abundances of Th and U, adjusted for radioactive decay, are adopted instead of meteoritic abundances. These ratios agree somewhat better with an r-process composition and a leakage lifetime of several million years. No trans-uranic nuclei were observed in the present flight. Serious consideration must be given to the possibility that most of the cosmic rays with $Z < 60$ originate from material of solar composition. One of the major new results of the study was the determination of an energy spectrum for the nuclei with $Z > 60$. If the integral-energy spectrum is given by $N (> E) \propto (E + M_0c^2)^{-\eta}$, where E is the kinetic energy per nucleon, then the spectral index for high-Z nuclei is $\eta = 2.75 \pm 0.53$ for 0.5 GeV/amu $\leq E \leq$ 2.0 GeV/amu. In the same energy interval the index for helium nuclei is $\eta = 1.3$. This may imply a different origin for high- and low-Z cosmic rays. (auth)

25372 NORTH AMERICAN MICROTEKTITES FROM THE CARIBBEAN SEA AND THEIR FISSION TRACK AGE. Glass, B. P. (Univ. of Delaware, Newark); Baker, R. N.; Storzer, D.; Wagner, G. A. Earth Planet. Sci. Lett.; 19: No. 2, 184-192 (Jun 1973).

Over 6000 microscopic glass spherules between 125 μm and 1 mm in diameter were found in a sediment core (RC9-58) from the Caribbean Sea. These glassy objects are mostly confined to a zone $\sim$40 cm thick at a depth of $\sim$250 cm. It is believed that the microscopic glass objects are microtektites belonging to the North American strewnfield, based on their geographical location, appearance, physical properties, stratigraphic age (middle Upper Eocene), fission track age ($\sim$34.6 my), and major element compositions. The occurrence of North American microtekites in the Caribbean Sea indicates that the North American strewnfield is two to three times larger than previously indicated. An estimate on the abundance of microtektites in core RC9-58 indicates that the North American strewnfield may contain greater than 10^{17} g of tektite material. (auth)

25373 THERMAL HISTORY OF THE NAKHLITES BY THE ^{40}Ar–^{39}Ar METHOD. Podosek, F. A. (California Inst. of Tech., Pasadena). Earth Planet. Sci. Lett.; 19: No. 2, 135-144 (Jun 1973).

The results of thermal-release argon analyses of neutron-irradiated samples of the two nakhlite meteorites, Lafayette and Nakhla, are reported. The initiation of retention of radiogenic ^{40}Ar in Lafayette appears to have been a reasonably well-defined event which occurred $(1.33 \pm 0.03) \times 10^9$ yr ago, as determined by the ^{40}Ar–^{39}Ar method. Nakhla also appears to have been retaining argon no longer than 1.3×10^9 yr, but its gas-retention age cannot be considered well-defined because its apparently most-retentive sites have nominal gas-retention ages shorter than those of the less-retentive sites which contain most of its potassium. (auth)

25374 CHEMICAL COMPOSITION AND RARE GAS CONTENT OF FOUR NEW DETECTED ANTARCTIC METEORITES. Shima, M.; Shima, M.; Hintenberger, H. (Max-Planck-Institut fuer Chemie, Mainz). Earth Planet. Sci. Lett.; 19: No. 2, 246-249 (Jun 1973).

Within a region of 5 km × 10 km on a downhill slope of the Yamato Mountians, in 1969 the Japanese Expedition Team collected many stones. Nine of them were recognized as meteorites. On 4 of these findings the chemical composition and the rare gas content were determined. According to the mineralogical and the chemical composition, Yamato (a) is an enstatite chondrite, Yamato (b) a Ca-poor achondrite, Yamato (c) seems to be a carbonations chondrite Type III, and Yamato (d) a olivine bronzite chondrite. Exposure ages are 1.7, 31, 25 and 4.3 my, respectively. (auth)

25375 YADERNYE REAKTSII V KOSMICHESKIKH TELAKH. (Nuclear Reactions in Cosmic Bodies). Lavrukhina, A. K. Moscow; Izdatel'stvo Nauka (1972). 254p.

The development of a model of the nuclear reactions taking place under the influence of cosmic radiation in meteorites and the surface layers of the Moon and asteroids is examined. Quantitative calculations were made of the depth distribution of nuclear active particles and cosmogenic isotopes in meteorites of the same composition and dimensions. It is shown that the nuclear reactions are the cause of anomalies observed in meteorites in the isotopic composition of elements in comparison with the rocks of Earth. (tr-auth)

Stars

Refer also to abstract 26467.

25376 THEORY OF RADIATION TRANSFER IN AN INHOMOGENEOUS MAGNETIC FIELD. Rachkovskii, D. N. Izv. Krym. Astrofiz. Observ.; 64-69(1972). (In Russian).

The equations of radiation transfer in the presence of magnetic field derived by Kai (1968), Beckers (1969), and the author (1970) are considered. It is shown that equations by Kai are not correct. The coefficient of anomalous dispersion in Beckers' equations is wrong by the factor two. The transfer equations are integrated numerically when direction of pure transverse field is changing by 45° discontinuously. It is found that in this case the line is split into two components with opposite circular polarizations. (auth)

25377 PECULIAR A STARS AND THE ORIGIN OF THE HEAVIEST CHEMICAL ELEMENTS. Kuchowicz, B. (Univ. of Warsaw). Quart. J. Roy. Astron. Soc.; 14: No. 2, 121-140(Jun 1973).

The unstable element promethium and such r-process products as uranium, and even transuranium elements have been observed recently in some peculiar A stars. Isotope shifts of the Pt and Hg lines in Ap stars point to an increased abundance of the neutron-rich isotopes of these elements. These observational results may be taken as evidence for an r-process which could be extended perhaps even to yield the superheavy nuclei from the "additional island of stability" around Z = 114. The synthesis of the heaviest chemical elements is considered in the framework of Guthrie's modified version of Van den Heuvel's theory of the origin of Ap stars. Other possibilities of explaining the anomalous abundances are related to the problem of nucleosynthesis of the heaviest chemical elements. (auth)

25378 WHITE DWARFS AS INFRARED SOURCES IN THE GALACTIC CENTRE. Chow, T. L.; Caroff, L. (California State Coll., Turlock). J. Phys., A (London); 6: No. 8, 1285-1288(Aug 1973).

It is suggested that infrared radiation from the galactic center is due to magnetic bremsstrahlung in intense magnetic fields from the nondegenerate layers of some white dwarfs. (auth)

25379 PERVASIVE BLACK HOLE. Carr, B. (Cambridge Univ., Eng.). New Sci.; 59: No. 858, 316-318(9 Aug 1973).

If general relativity is to be believed then the existence of black holes, that is regions of space from which light can never escape is almost unavoidable. The theory that black holes are formed by stellar collapse is considered and such a hole, formed when the collapsing star is spherically symmetric and nonrotating, is described. If the collapsing star is not symmetrical the question whether it will still collapse to a singularity with the formation of an event horizon which hides this singularity from an outside observer is considered. It is thought that all black holes will probably settle down to a Kerr solution (the solution to Einstein's equations which represents a uniformly rotating black hole) in a fraction of a second. Because of this the final state and properties of black holes can be described with some confidence. The detection of black holes is considered and the reasons for suspecting that the Cygnus X-1 system includes a black hole are considered. The existence of giant and little black holes is discussed and a note of caution sounded that black holes are as pervasive in theory as they are evasive in observation. (UK)

25380 SPECTROCOLORIMETRIC OBSERVATIONS OF FLARES OF EV LAC. Chugainov, P. F. Izv. Krym. Astrofiz. Observa.; 44: 3-10(1972). (In Russian).

Absolute measurements of continuous radiation of three flares of EV Lac were obtained. The device used—photoelectric spectrocolorimeter—gave the possibility to record simultaneously the stellar brightnesses in the following spectral regions: λλ3350 to 3650, 4155 to 4280, and 5120 to 5320 Å. It was found that emission Balmer jump has moderate values on ascending and descending branches of flares and the smaller ones near the maxima of brightness. The distribution of energy in spectra of flares differs from that of the recombination radiation due to recombination process (free-free + free-bound transitions) as well as from the blackbody radiation. (auth)

25381 BALMER DECREMENT IN FLARE SPECTRA OF THE UV CET TYPE STARS. Gershberg, R. E.; Kaplan, S. A. (Gorky State Univ., USSR). Izv. Krym. Astrofiz. Observ.; 44: 11-17 (1972). (In Russian).

The results of spectrophotometric investigation of the EV Lac flare on July 12, 1966—the relative intensities and equivalent widths of emission lines—are given. Rather flat Balmer decrement of this flare differs essentially from the decrement of the same star's flare on Dec. 11, 1965 when the inverse ratios of hydrogen line intensities were observed. For the preliminary interpretation on the observed variety of Balmer decrements a model of stationary radiating medium having a velocity gradient and large optical thicknesses in the lines of several first spectral series was considered. This model gives the possibility to obtain both normal and inverse Balmer line intensity ratios by charging one parameter being a function of temperature and emission measure of the radiating layer. More complicated theory of Balmer decrement allows to interpret both Balmer line intensity ratios and H_δ equivalent widths observed in the EV Lac flare on July 12, 1966. (auth)

25382 ANOMALOUS ABUNDANCE OF THE LITHIUM IN THE ATMOSPHERE OF THE STAR 105 HER. Boyarchuk, M. E. Izv. Krym. Astrofiz. Observ.; 44: 18-32(1972). (In Russian).

Five spectrograms of K4 II star 105 Her (dispersion ~12 Å/mm) in the region 6870 to 5800 Å were investigated by the curves of growth method. The equivalent widths of 580 absorption lines were measured. The physical parameters of stellar atmosphere obtained were as follows: turbulent velocity $\nu_t = (2.6 \pm 0.4)$ km/sec, excitation temperature $\Theta_B = (5040/T_B) = 1.48 \pm 0.02$, electron pressure $\lg p_e = -2.03 \pm 0.15$, coefficient of continuous absorption per one hydrogen atom $\lg \varkappa = -26.28$. It is shown, that lithium is about 6 times overabundant in comparison with the Sun and $\sim 2 \cdot 10^2$ times overabundant, when compared with the average Li abundance in K 4 stars. The abundances of other elements do not differ significantly from the solar ones. (auth)

25383 SYNCHROTRON SPECTRUM OF THE CRAB NEBULA BEYOND THE LYMAN LIMIT. Golovatyi, V. V.; Pronik, V. I. Izv. Krym. Astrofiz. Observ.; 44: 33-39(1972). (In Russian).

The flux density and spectral index of the Crab Nebula synchrotron radiation in the region λλ 912 to 90 Å was obtained using Zanstra's method. The spectrum obtained can be very smoothly "joined" to the optical data corrected for the interstellar absorbtion, if the value $A_v = 1.6$ m is accepted. The considerable difference of spectral indexes in the ultraviolet region λλ 912 to 90 Å ($\alpha = 0.6$) and x-ray region ($\alpha = 1.4$) indicates probably a bend in the spectrum near the frequency of 10^{17} Hz. The probable errors of flux density and spectral index are evaluated. (auth)

25384 EVOLUTION OF A CLOSE BINARY WITH MASS LOSS FROM THE SYSTEM. Yungel'son, L. R. (Astronomical Council, Academy of Sciences of the USSR). Sov. Astron.–AJ 16: No. 5, 864-866 (Mar 1973).

The results are reported for the evolution of the initially more massive component losing mass in a close binary system. Two cases are considered: 1) 25% of the mass lost by the primary leaves the system; 2) the mass and angular momentum of the system are conserved. The allowance for mass loss from the system improves the agreement between the theoretical models and the observational data. (auth)

25385 DISK MODEL OF GAS ACCRETION ON A RELATIVISTIC STAR IN A CLOSE BINARY SYSTEM. Shakura, N. I. (P. K. Shternberg State Astronomical Institute). Sov. Astron.–AJ 16: No. 5, 756-762 (Mar 1973).

A model of close binary system incorporating a relativistic (neutron or collapsed) star is considered. The formation of the disk around the relativistic star and the energy flux radiated by the disk are analyzed. It is shown that the model can be used to explain the properties of galectic x-ray sources with a thermal emission spectrum. (auth)

25386 POLARIZATION OF THE RADIATION OF MAGNETIC STARS. Demkina, L. B.; Obridko, V. N. (Institute of Terrestrial Magnetism, the Ionosphere, and Radio-Wave Propagation, Academy of Sciences of the USSR). Sov. Astron.–AJ 16: No. 5, 853-855 (Mar 1973).

The polarization of the radiation of magnetic stars arising from the Zeeman effect cannot exceed 1%. The wavelength dependence of the polarization in the range 4152–4262 Å has been computed for ϵ UMa. (auth)

25387 EVOLUTION OF OPEN STAR CLUSTERS THROUGH DISSIPATION. Kaliberda, V. S. (Leningrad University). Sov. Astron.–AJ 16: No. 5, 837-842 (Mar 1973).

Equations describing the evolution of clusters by evaporation of stars are derived, and the time dependence of the cluster parameters is determined. The method is applied to the evolution of the Pleiades. The dissipation of this cluster accelerates with time, and it will be fully dispersed after 21 relaxation periods. The total energy of the cluster is diminishing, so that the system parameters are changing more rapidly than if the total energy were assumed constant. (auth)

25388 SUPERNOVAE AND SOURCES OF X-RAY RADIATION. Shklovskii, I. S. (Institute of Space Research, Academy of Sciences of the USSR, Moscow). Sov. Astron.–AJ 16: No. 5, 749-755 (Mar 1973).

It has been shown that a major portion of the x-ray radiation of Cassiopeia A is thermal radiation from a hot nonisothermal plasma behind a shock-wave front. The x-ray radiation from the remnants of the 1572 supernova (Tycho) can be neither thermal radiation nor the high-frequency continuation of this object's synchrotron radio emission.

Attention is directed to the "isotropic" component of the optical and x-ray radiation of the pulsar NP 0532. The x-ray radiation from the remnants of Supernova 1572 may be the isotropic component of the emission of a pulsar located there whose rotational axis is oriented "unfavorably" with respect to us. Approximate equations are derived for the evolution of the synchrotron radiation of pulsars on the basis of which the possibility of optical observations of a pulsar in the remnant of the outburst of Supernova 1572 is predicted. The problem of the evolution of the x-ray radiation of supernovae during the early stages of their development is investigated. It has been shown that this radiation can, in principle, explain the light curves of Type I supernovae. It is shown that the x-ray radiation from these objects which flare up within a distance of 30 Mpc can be observed several months after the outburst. (auth)

25389 EVOLUTION OF A MAIN-SEQUENCE STAR OF 16 SOLAR MASSES TO A RED SUPERGIANT. Varshavskii, V. I. (Astronomical Council, Academy of Sciences of the USSR). Sov. Astron.-AJ 16: No. 5, 861-863 (Mar 1973).

An evolutionary sequence of models for a star of 16 $M_\odot$ has been calculated up to the stage of helium exhaustion in the convective core. A carbon-oxygen core of mass 3.0 $M_\odot$ is formed. During the principal helium-burning state in the core, the star describes a loop in the red-supergiant region of the H-R diagram, and instability sets in. (auth)

25390 THE TRIPLY PERIODIC WHITE DWARF HL TAU-76. Fitch, W. S. (Steward Observatory). Astrophys. J. Lett. 181: No. 2, L95-L98 (15 Apr 1973).

Analysis of 1530 differential blue magnitudes of HL Tau-76 shows that this star is apparently a regular, triply periodic variable with little or no random noise in the extremely complex light variation. The star has two excited pulsation modes (periods $P_0 \simeq 12.436$ and $P_1 \simeq 8.237$ min) which are nonlinearly coupled together and which are nonlinearly modulated by a "long" period $P_l \simeq 0.135$ day. (auth)

25391 SOLIDIFICATION OF NEUTRON MATTER. Canuto, V.; Chitre, S. M. (Institute for Space Studies, National Aeronautics and Space Administration, Goddard Institute for Space Studies, New York, New York, 10025). Phys. Rev. Lett. 30: No. 20, 999-1002 (14 May 1973).

A t-matrix calculation of the ground-state energy of cold neutron matter has been performed and it is shown that neutron matter solidifies at a density of the order of 1.6×10^{15} g/cm^3, thus implying the existence of a solid core inside heavy neutron stars. (auth)

25392 THE PRODUCTION OF DEUTERIUM IN SUPERNOVA SHOCKS. Colgate, S. A. (New Mexico Institute of Mining and Technology, Socorro). Astrophys. J. Lett. 181: No. 2, L53-L54 (15 Apr 1973).

A strong shock in the stellar envelope of a Type II supernova speeds up in the density gradient. Because of the low density, the equilibrium temperature behind the shock may be relatively low—a few times 10^7 degrees—despite the high relative nuclear kinetic energy (E_i) up to many MeV per nucleon. The radiation equilibrium mechanisms, bremsstrahlung and inverse Compton scattering, are slow compared with ion-ion thermalization. Consequently, a high-temperature ion precursor forms ($kT_i \simeq 2/3 E_i$) that lasts for 100 $E_i^{1/2}$ (E_i in MeV) Thomson-scattering periods ($1/n_e \sigma_T c$) sufficient to allow from 60 to 90 proton-alpha and alpha-alpha collisions at $E_i \simeq 10$ MeV. This is the minimum energy at which the alphas will be spalled to free neutrons and protons. Subsequent capture of the neutrons by the protons is assured at a low enough equilibrium temperature that the deuterium survives and is ejected. A shock strength of 10 MeV per nucleon should occur at a mass fraction of a few times 10^{-3}, producing a fraction of a few times 10^{-4} deuterium per supernova. A processing of 10 percent of the galactic mass through Type II supernovae is adequate to produce the observed deuterium. (auth)

25393 THE RADIATIVE INTERACTION AND EVOLUTION OF MEDIUM- AND LOW-MASS BINARIES. Koch, R. H. (Department of Astronomy, University of Pennsylvania, Philadelphia, Pennsylvania). Astron. J. 78: No. 5, 410-412 (June 1973).

The spectral types of the cool components of numerous close binaries are computed on the assumption of convective envelopes for these components. Difficulties of interpreting moderate- and low-mass systems with theoretical cases A and B of binary evolution are described. Possible solutions for these problems are briefly described. (auth)

25394 ON THE METALLICITY OF THE MAIN-SEQUENCE STARS IN M67. Morgan, W. W. (Yerkes Observatory, University of Chicago, Williams Bay, Wisconsin 53191); Abt, H. A. Astron. J. 78: No. 5, 386-388 (June 1973).

New determinations of the spectral types of six of the seven stars discussed by Spinrad, Greenstein, Taylor, and King (1970) in M67 have been carried out; the same spectrograms used by Spinrad et al., kindly loaned by Dr. A. R. Sandage, were used for the purpose. The results do not confirm the discovery by Spinrad et al. that there is a pronounced difference in spectral types determined from the hydrogen lines and those from the metallic lines — in the sense that the metallic line types are later. Our redetermination of the spectral types shows that there is no appreciable difference between those from the H lines and those from the metallic lines. New determinations of the color excess from hydrogen and from metallic-line spectral types result in values of $E(B-V) = +0.^m04$ and $+0.^m05$, respectively. These agree well with the value of Eggen and Sandage of $+0.^m06$, and disagree with that of Spinrad et al. [$E(B-V) = +0.11$ to $+0.09$]. (auth)

25395 PHOTOELECTRIC PHOTOMETRY OF 47 TUC. Menzies, J. (Oxford Univ.). Mon. Notic. Roy. Astron. Soc.; 163: No. 3, 323-329(1973).

A colour-magnitude and a two-colour diagram are presented for the southern hemisphere globular cluster 47 Tuc. These are based on UBV photoelectric photometry of 60 stars brighter than $V \sim 15.7$m. The colour-magnitude diagram is probably more reliable than any of the photographically determined ones in the current literature. For a reddening of $E_{B-V} = 0.08$m, the ultraviolet excess at $(B-V)_0 = 1.0$ m is $\delta(U-B) = 0.06 \pm 0.04$m, and the giant branch is characterized by $\Delta V = 2.0$m and $(B-V)_{0,g} = 0.92$m. (auth)

25396 LITHIUM IN K-SUPERGIANTS. Warren, P. R. (Radcliffe Observatory, Pretoria). Mon. Notic. Roy. Astron. Soc.; 163: No. 3, 337-344(1973).

The lithium abundances in 20 K-supergiants are discussed. The highest values obtained are a factor of 10 less than the maximum values reached in stars. The ratio of the numbers of supergiants with high lithium abundances to those with low is consistent with that predicted by Iben's (Astrophys. J.; 142: 1447(1965)) evolutionary tracks. (auth)

25397 PHOTOGRAPHIC PHOTOMETRY OF THE OPEN CLUSTER M35. Vidal, N. V. (Tel Aviv Univ., Israel). Astron. Astrophys., Suppl. Ser.; 11: No. 1, 93-106(Jul 1973).

UBV photographic photometry of 436 stars in the region of M35 is presented. Using a recent proper motion survey, C-M and C-C diagrams for probable cluster members are drawn. It is found that M35 is as young as the Pleiades. Salpeter's initial luminosity function seems to fit best the luminosity function for cluster members. (auth)

25398 SPECTRA INDEX DISTRIBUTION OF RADIO SOURCES SELECTED FROM THE B2 SKY SURVEY. Grueff, G.; Vigotti, M. (Univ., Bologna). Astron. Astrophys., Suppl. Ser.; 11: No. 1, 41-66(Jul 1973).

Measurements at 5 GHz of B2 radio sources are presented. The distribution of the spectral index between 408 MHz and 5000 MHz is discussed. The data indicate the existence of a correlation between the average spectral index and the parameter R defined as the ratio between the radio and optical power, for quasi-stellar sources. The spectral data are also used to gain information about the nature of sources with no optical counterpart on the Palomar Sky Survey (Empty Fields). (auth)

25399 EQUIVALENT WIDTH DATA FOR SUPERGIANTS OF TYPE G AND K Ib. van Paradijs, J. (Univ., Amsterdam). Astron. Astrophys., Suppl. Ser.; 11: No. 1, 25-40(Jul 1973).

The equivalent widths of lines, used in a curve of growth analysis of seven supergiants of type G and K Ib are presented and compared with data from other studies. (auth)

25400 PHOTOGRAPHIC UBV PHOTOMETRY OF TEN OPEN STAR CLUSTERS IN A GALACTIC FIELD AT $l = 135°$. Moffat, A. F. J.; Vogt, N. (Ruhr-Univ., Bochum, Ger.). Astron. Astrophys., Suppl. Ser.; 11: No. 1, 3-23(Jul 1973). (In German).

In a field $5° \times 5°$ just NE of h and χ Persei, photographic UBV photometry ($V \leq 16.5$) was carried out in ten open clusters for which no previous UBV data exist. Three of these are well defined young clusters, suitable as spiral arm tracers. (WDM)

25401 INFRA-RED PHOTOMETRY OF RED GIANTS IN THE GLOBULAR CLUSTERS 47 TUC AND ω CEN. Glass, I. S. (Royal Observatory, Cape Town); Feast, M. W. Mon. Notic. Roy. Astron. Soc.; 163: No. 3, 245-260(1973).

J,H,K,L. (1.25 to 3.5 μ) photometry and some spectral types are given for red giants (including variables) in 47 Tuc and ω Cen. Bolometric corrections were derived for those stars which also have U,B,V,R, I photometry (from Eggen). These bolometric corrections are close to those for Population I giants of the same colours. For both clusters the relations between the various colours (and between the colours and TiO spectral types) are similar to those for Population I giants. The excess in the H band (probably mainly an H^- opacity minimum) is found in all stars including the ω Cen M type variables but excluding the three Miras in 47 Tuc. The photometry of the ω Cen M type

variables confirms that they are cool objects (log $T_{eff} \sim 3.50$). These variables have considerable (~), (U-B) excesses for their types and infrared colours, presumably due to metal deficiency. The TiO bands are as strong in these stars as in Population I giants of the same infrared colours. This probably indicates that TiO is itself an important source of opacity in these stars. These stars probably represent an early stage in the rapid evolution from the top of the asymptotic giant branch. There is evidence for a small 3.5 μ(L) excess in 47 Tuc V3, and possibly also in ω Cen V6. (auth)

25402 NUMERICAL TREATMENT OF DOUBLE SHELL SOURCE STARS. Eggleton, P. P. (Cambridge Univ., Eng.). Mon Notic. Roy. Astron. Soc.; 163: No. 3, 279-284(1973).

A technique for computing the evolution of stars with a narrow hydrogen-burning shell source, described by Eggleton (Mon. Not. R. Astr. Soc.; 151: 351(1971) and 156: 361(1972)), has been applied to a model which developed narrow hydrogen and helium burning shells. The technique allows time steps to be taken which are substantially longer than the growth time of the helium shell instability (Schwarzschild & Harm, Astrophys. J.; 142: 855(1965)) and it is found that this physical instability is numerically suppressed. The test model, a Population I star of 4 $M_\odot$, was followed from the main sequence until it had developed a carbon core of 1.28 $M_\odot$. (auth)

25403 IMPORTANCE OF MOLECULAR RAYLEIGH SCATTERING IN THE ATMOSPHERES OF VERY LATE-TYPE STARS. Tarafdar, S. P.; Vardya, M. S. (Tata Inst. of Fundamental Research, Bombay). Mon. Notic. Roy. Astron. Soc.; 163: No. 3, 261-277(1973).

The importance of Rayleigh scattering by various molecules, atoms, and ions at low temperatures has been examined for three hydrogen deficient elemental compositions. The major contributors to the Rayleigh scattering have been found to be C_3 and N_2, though many other molecules, atoms, and ions contribute not insignificantly. A comparison between the Rayleigh scattering by C_3 and N_2 with absorption by negative ions and electron scattering suggests that the Rayleigh scattering by these molecules may be important in the atmospheres of cool hydrogen deficient giant and supergiant stars. (auth)

25404 RED STARS IN THE LARGE MAGELLANIC CLOUD. Mendoza, E. E.; Gomez, T. (Univ. Nacional Autonoma de Mexico, Mexico City). Publ. Astron. Soc. Pac.; 85: No. 506, 439-455 (Aug 1973).

Ultraviolet and infrared photographic plates were obtained of the Large Magellanic Cloud. The plates are centered near the 30 Doradus nebula and cover an area of approximately 60′ × 75′. The filters and emulsions employed are adequate to discover "red stars". Finding charts, right ascension, declination, and infrared magnitudes are given for 205 red stars, many of which probably belong to the Large Magellanic Cloud. Since the Cloud's interstellar extinction is generally small, the great majority of these red objects are undoubtedly late-type stars. Those with color index (U−I) larger than six magnitudes could be carbon stars or supergiants with spectral types later than M2. (auth)

25405 NATURE OF NGC 6231-92. Robinson, G. (Univ. of Melbourne); Thomas, J. A.; Hirst, R. A.; Hyland, A. R. Publ. Astron. Soc. Pac.; 85: No. 506, 436-438(Aug 1973).

Infrared photometric observations of NGC 6231-92 are presented. The alternative possibilities that either the reddening is purely interstellar or is produced by an extremely cool circumstellar shell are briefly discussed. (auth)

25406 ROLE OF ROTATION IN CLOSE BINARY SYSTEMS OF HIGH MASS. Stothers, R. (Goddard Space Flight Center, New York). Publ. Astron. Soc. Pac.; 85: No. 506, 363-378 (Aug 1973).

A quantitative confrontation of theory and observation of massive close binary systems is presented in order to evaluate the role of axial rotation in the evolution of the individual stellar components as well as of the system as a whole. The detached systems are essentially unevolved, and possess components in approximately uniform rotation. The semidetached systems are definitely evolved, having suffered a heavy mass exchange before the stage of hydrogen exhaustion at the center of the original primary, and often possess mass-gaining components in fast nonuniform rotation. Except in the case of wide systems (P > 2 days), tidal friction eventually reinduces synchronism of rotation in both components and both components evolve inhomogeneously. Spin-down times of the envelope and core, total rotational angular momenta, and effects of spin-orbit interaction are calculated. A number of unexplained phenomena remain. (auth)

25407 LUMINOSITY AND VELOCITY DISTRIBUTION OF HIGH LUMINOSITY STARS NEAR THE SUN. II. The Young Disk Giants. Eggen, O. J. (Australian National Univ., Canberra). Publ. Astron. Soc. Pac.; 85: No. 506, 379-395(Aug 1973).

A sample of red giants (luminosity class III) of the young-disk population including all brighter than intrinsic visual magnitude 5.0m and redder than $(R - I)_0 = +0.40$ (~K2) is discussed on the basis of UBVRI photometry and accurate apparent motions. The domain in the (U,V) plane of the young-disk population is defined by another sample of stars brighter than visual magnitude 6.0m, in the temperature range characterized by β = 2,880 to 2.840 and with a luminosity between that of the ZAMS and the Hyades cluster stars, as derived from intermediate-band photometry. A half dozen young-disk clusters are also included. The giant sequence, populated by these red giants, probably has a luminosity width less than one magnitude. Some narrow-band indices published by McClure (1970) and Dickow et al. (1970) are discussed in connection with this width. The (U,V) distributions of the red giants and of their main-sequence progenitors are strikingly similar. The luminosity function of the red giants and the density of both the giants and their progenitors in the solar neighborhood indicate continuous star formation over most of the life of the Galaxy. (auth)

25408 CONTINUUM OBSERVATIONS OF SOME HOT HELIUM-RICH STARS. Rosendhal, J. D.; Schmidt, E. G. (Univ. of Arizona, Tucson). Publ. Astron. Soc. Pac.; 85: No. 506, 396-400(Aug 1973).

Measurements are presented of the continuous energy distributions of six hot, helium-rich stars. The data have been used to determine the size of the Balmer discontinuities in all program stars and a search has been made for evidence for the presence of the helium discontinuity at λ3422. (auth)

25409 VISUAL BINARIES IN PLANETARY NEBULAE. Cudworth, K. M. (Univ. of California, Santa Cruz). Publ. Astron. Soc. Pac.; 85: No. 506, 401-402(Aug 1973).

Close companions to the central stars have been observed in several planetary nebulae. Proper motions for some of these are consistent with physical association. (auth)

25410 He II LINE-PROFILE VARIATIONS IN THE WOLF–RAYET STAR EZ CANIS MAJORIS. Irvine, C. E.; Irvine, N. J. (Case Western Reserve Univ., Cleveland). Publ. Astron. Soc. Pac.; 85: No. 506, 403-404(Aug 1973).

Observations of variations in the profile He II λ4686 in the WN5 star EZ CMa provide additional evidence for the binary nature of this object. (auth)

25411 Be STARS IN THE GALACTIC CLUSTER M52. Bond, H. E. (Lousiana State Univ. Observatory, Baton Rouge). Publ. Astron. Soc. Pac.; 85: No. 506, 405-407(Aug 1973).

It is shown that the galactic cluster M52 (NGC 7654) contains several emission-line B-type stars. Published photometry shows that these Be stars lie at positions in the cluster color-magnitude diagram where stars are still undergoing main-sequence core hydrogen burning. (auth)

25412 TRIPLE STAR A 1813. Heintz, W. D. (Swarthmore Coll., PA). Publ. Astron. Soc. Pac.; 85: No. 506, 408-409(Aug 1973).

Orbital elements, masses, and ephemerides of the system were derived. (auth)

25413 UBV PHOTOMETRY OF 1 MONOCEROTIS. Millis, R. L. (Lowell Observatory, MA). Publ. Astron. Soc. Pac.; 85: No. 506, 410-419(Aug 1973).

Observations of the δ Scuti star 1 Mon were made on 17 nights during 1971 and 1972. The amplitude of the V light curve varies between 0.36 m and 0.03 m with a period of 7.7455 ± 0.0005 d. It is shown that the amplitude variation results from the simultaneous excitation in the star of two periods $-P_1 = 0.13377 \pm 0.00001$ d and $P_2 = 0.13613 \pm 0.00001$ d. The amplitudes of the brightness variations associated with these two periods are nearly equal. (auth)

25414 PERIOD STUDY FOR RS CEPHEI. Hall, D. S.; Cannon, R. O. III; Rhombs, C. G. (Vanderbilt Univ., Nashville). Publ. Astron. Soc. Pac.; 85: No. 506, 420-422(Aug 1973).

All available times of minimum for RS Cep were collected and analyzed to show that the period has not been constant but, in one possible interpretation of the data, increased rather suddenly around 1940 by $\Delta P/P = 2 \times 10^{-5}$. (auth)

25415 LIGHT CURVE FOR ECLIPSING BINARY SYSTEMS WITH AN EXTENSIVE ATMOSPHERE. Chochol, D. (Astronomical Inst., Tatranska Lomnica, Czech.). Bull. Astron. Inst. Czech.; 24: No. 4, 243-245(1973).

A model of an eclipsing binary system is considered, assuming spherical symmetry of both components. The first component is a star with an extensive atmosphere, and as regards the second component a uniform disk is assumed. The model was applied to the V444 Cygni system. The theoretical light curve was computed for the primary minimum, and the optimum parameters were found for the extensive atmosphere. A comparison was made with the photometric light curve obtained by Kron and Gordon (1950). (auth)

25416 GENERALIZATION OF RELATIONS BETWEEN THE FREQUENCY DISTRIBUTION FUNCTIONS OF ASTRONOMICAL PHENOMENA AND OBJECTS ACCORDING TO THEIR AGE AND LIFETIME. Kopecky, M.; Suda, J. (Astronomical Inst., Ondrejov, Czech.). Bull. Astron. Inst. Czech.; 24: No. 4, 173-183 (1973).

Relations between the frequency distribution function of phenomena according to their lifetime, age, and other parameters are derived, provided that both the number of phenomena arising per unit time and the frequency distribution of phenomena according to their lifetime depend on time. On the basis of these relations, other statistical parameters and relations like the average lifetime, the average time of existence of phenomena in a certain time interval, etc., are derived and discussed. The solution of statistical problems, if the number of originating phenomena per unit time f_0 and their frequency distribution function, according to their lifetime, or according to other parameter, are functions of time, is very complicated and in most astronomical and astrophysical problems practically impossible. That is why it is necessary to assume the independence of these functions on time. One should, however, keep in mind that the results obtained in this way need not be accurate and in many cases they can be quite incorrect. This is demonstrated on some concrete astrophysical problems (relation between pulsars and supernovae, initial mass function of stars, average lifetime of groups of sunspots real average length of telescopic meteors). (auth)

25417 MOLODYE ZVEZDNYE KOMPLEKSY. Astroklimat. (Young Stellar Complexes. Astroclimate). Shevchenko, V. S. (ed.). Tashkent; Izdatel'stvo Fan (1972). 180p.

The papers deal with the physical nature and activity of nonstationary stars in very young clusters and T-associations. Investigations of the "astroclimate" at elevated sites in Middle Asia are discussed, and the nature of the optical instability of the Earth's atmosphere is studied. Astroclimate is understood to mean the conditions of atmospheric optics as they affect the observation of stars. Separate abstracts were prepared for four of the papers. (IAA)

For abstracts of individual papers see: 25418–25421.

25418 NEW INFRARED OBJECTS IN ORION. Shevchenko, V. S. pp 3-7 of Molodye Zvezdyne Komplesky. Astroklimat. Shevchenko, V. S. (ed.). Tashkent; Izdatel'stvo Fan (1972). (In Russian).

Fifteen objects characterized by anomalously large V-I and V-J color indices, detected in the region of the Great Nebula of Orion are discussed and their possible origin is assessed. Preliminary temperature measurements range from 1000 to 2000°K. Considerations are outlined in support of the view and the objects belong to an evolutionary stage preceding the T Tau stage. (IAA)

25419 O-B STARS IN YOUNG STAR CLUSTERS ASSOCIATED WITH NEBULAE. Kardopolov, V. I. pp 8-25 of Molodye Zvezdnye Kompleksy. Astroklimat. Shevchenko, V. S. (ed.). Tashkent; Izdatel'stvo Fan (1972). (In Russian).

Five stars in the Great Nebula of Orion and the S Mon star are studied by spectral photoelectric techniques. It is shown that the brightness variation amplitude obtained from photoelectric data is by one or two orders smaller than that obtained from photographic and visual estimates. This discrepancy is attributed to the difficulties involved in determining the nebula background in the latter observations. The lower brightness of these stars as compared to stars of the main sequence is attributed to their youthful stage of evolution. Anomalies in the energy distribution in the stellar spectra are attributed to radiation transfer with "micronebulae" associated with the stars. (IAA)

25420 RELATIONSHIP BETWEEN T-ASSOCIATIONS AND THE INTERSTELLAR MEDIUM IN THE NORTHERN REGION OF THE MONOCEROS COMPLEX. Slutskii, V. E. pp 29-46 of Molodye Zvezdnye Kompleksy. Astroklimat. Shevchenko, V. S. (ed.). Tashkent; Iadatel'stvo Fan (1972). (In Russian).

The structure of absorption in the region of NGC 2264 and Cr 95 in the Mon complex is studied on the basis of Palomar Sky-Survey Prints. A morphological relationship between objects with H-alpha emission, the absorbing medium, and interstellar hydrogen is established. The absence of anomalies in the absorption law in the region studied is demonstrated. (IAA)

25421 LIGHT CURVES OF THE ORION VARIABLES. Nurmukhamedov, M. G. pp 52-83 of Molodye Zvezdnye Kompleksy. Astroklimat. Shevchenko, V. S. (ed.). Tashkent; Izdatel'stvo Fan (1972). (In Russian).

The behavior of the brightness of 23 variables in the Large Nebula of Orion is determined from 292 negatives. Eight stars with reliably established activity characteristics are selected for future multicolor photoelectric observations. (IAA)

25422 NEW DIRECTIONS AND NEW FRONTIERS IN VARIABLE STAR RESEARCH. Fifth Conference on Variable Stars, Bamberg, Germany, August 31–September 3, 1971. Int. Astron. Union Symp.; No. 15, 1-337(1971).

New phenomena in very cool, very young, or very peculiar variables are treated in terms of polarization, microwave emissions, and other processes. Recent campaigns and new insights on flare stars, and rapid and ultrarapid variables (including x-ray sources) are discussed. Duplicity and its consequences among the intrinsic variable stars is considered, dealing with variable stars in general, eruptive variables in particular, and with contact binaries. Variable star observations from outside the Earth's atmosphere are reviewed. Individual items are announced in this issue. (IAA)

For abstracts of individual papers see: 25423–25434, and 25450.

25423 MICROWAVE EMISSION FROM STARS. Schwartz, P. R. Int. Astron. Union Symp.; No. 15, 44-50(1971).

From 5th conference on variable stars; Bamberg, Germany (31 Aug 1971).

An attempt is made to summarize the observations of masered emission from stars and to outline some basic conclusions that can be drawn from the data. The association of masered microwave emission with well studied objects like stars makes it possible to use the information gathered by conventional optical observations to attack the general masering problem and, conversely, the radio observations may be used to obtain information about a star not readily accessible optically, such as the mass loss rate or the physical conditions in a circumstellar shell. (IAA)

25424 FLARE STARS. Ambartsumian, V. A.; Mirzoian, L. V. Int. Astron. Union Symp.; No. 15, 98-108(1971).

From 5th conference on variable stars; Bamberg, Germany (31 Aug 1971).

The latest data on flare stars are set forth in the light of their meaning for the problem of stellar evolution. Major attention is given to observational data relating to flare stars in associations and clusters. The spatial distribution of flare stars and their abundance in stellar aggregates is discussed. The relation between the stages of RW Aurigae and the flare star, the spectra of flare stars, and the Hertzsprung–Russell diagram of flare stars are considered. Attention is given to the amplitudes, frequencies, energies, proper colors, the physical nature of flares, and "fast" and "slow" flares. An interpretation is given of the difference between slow and fast flares and the phenomenon of fuors. The luminosities and masses of flare stars, and their unusual distribution in the Pleiades is discussed. There appears to be no doubt that the flare stars form one of the initial stages in the evolution of dwarf stars. (IAA)

25425 SPECTRAL INVESTIGATIONS OF UV CETI-TYPE FLARE STARS AND SEARCH FOR NEW VARIABLES OF THIS TYPE CARRIED OUT AT CRIMEA. Gershberg, R. E.; Shakhovskaya, N. I. Int. Astron. Union Symp.; No. 15, 126-137(1971).

From 5th conference on variable stars; Bamberg, Germany (31 Aug 1971).

25426 RED DWARF STARS OF THE UV CETI-TYPE IN THE NEIGHBORHOOD OF THE SUN. Shakhovskaya, N. I. Int. Astron. Union Symp.; No. 15, 138-143(1971).

From 5th conference on variable stars; Bamberg, Germany (31 Aug 1971).

25427 TECHNIQUES AND RESULTS OF OBSERVATIONS OF RAPID AND ULTRARAPID VARIABLE STARS. Warner, B. Int. Astron. Union Symp.; No. 15, 144-159(1971).

From 5th conference on variable stars; Bamberg, Germany (31 Aug 1971).

The modern methods available for study of rapid changes of brightness in stars are reviewed, and some of the results obtained from applications of these techniques are discussed. Nearly all the objects of interest are fainter than magnitude 12, and the majority are fainter than magnitude 14. In order to study rapid

light variations in such objects it is necessary to use large telescope apertures and high quantum efficiency. By comparison with conventional UBV photometry some requirements may be relaxed but others need additional attention. The equipment used at McDonald Observatory is described in detail. Some practical aspects of using the two-channel photometer are discussed, giving attention to scintillation and the application to cataclysmic variables. Observations of HL Tau-76, optical fluctuations of x-ray sources, and synchronous photometry of DQ Herculis and of NP 0532 are treated. (IAA)

25428 HIGH-FREQUENCY STELLAR OSCILLATIONS: THE CERRO TOLOLO SEARCH FOR LUMINOSITY-VARIABLE WHITE DWARFS. Hesser, J. E.; Lasker, B. M. Int. Astron. Union Symp.; No. 15, 160-168(1971).

From 5th conference on variable stars; Bamberg, Germany (31 Aug 1971).

The techniques and procedures of time-series monitoring and Fourier analysis used at Cerro Tololo to search for luminosity variations in white dwarfs are summarized. Further null results from this program, which are applicable to the problem of defining the region of white-dwarf variability in the HR-diagram, are considered; and the properties of the four known variables are reviewed as possible archetypes of a group. (auth)

25429 DUPLICITY AND ITS CONSEQUENCES AMONG VARIABLE STARS IN GENERAL. Larsson-Leander, G. Int. Astron. Union Symp.; No. 15, 185-195(1971).

From 5th conference on variable stars; Bamberg, Germany (31 Aug 1971).

The consequences of stellar duplicity for variable stars in general are reviewed. Gravitational effects, radiation effects, and effects due to gaseous streams and mass transfer are considered. The possibility of tidal interactions, modulating the pulsations of beta CMa and delta Sct variables, is among the topics treated in some detail. (auth)

25430 SPECTRUM VARIABLE α CENTAURI/HD 125 823/. Klinglesmith, D. A. (Goddard Space Flight Center, Greenbelt, MD). Int. Astron. Union Symp.; No. 15, 205-216(1971).

From 5th conference on variable stars; Bamberg, Germany (31 Aug 1971).

25431 EFFECT OF BINARY MOTION ON PERIOD CHANGES IN RR LYRAE STARS. Coutts, C. M. Int. Astron. Union Symp.; No. 15, 238-242(1971).

From 5th conference on variable stars; Bamberg, Germany (31 Aug 1971).

The investigation was carried out to determine what apparent period changes, if any, would result from binary motions. In particular, it is important to know whether or not such apparent period changes could be mistaken for intrinsic period changes caused by evolution. Not many binaries are known among RR Lyrae stars. However, Epps (1971) has pointed out that from the work of Jones (1970) it appears that the frequency of visual companions to RR Lyrae stars does not differ from other stars when distances and magnitude differences are taken into account. (IAA)

25432 ERUPTIVE BINARIES. Smak, J. Int. Astron. Union Symp.; No. 15, 248-267(1971).

From 5th conference on variable stars; Bamberg, Germany (31 Aug 1971).

The ultimate goal of studies of eruptive binaries is (1) to solve the problems of the evolutionary origin of these objects and of the observed variety of their types, (2) to study the mechanism, or mechanisms of their outbursts and other types of the nova-like variability, and (3) to study the role of eruptive binaries in the evolution of the Galaxy. The aim of the review is to discuss selected topics which seem to be most important. Eruptive binaries are classified as novae, with a subtype of recurrent novae, U Gem type stars with a subtype of Z Cam variables, and nova-like objects. A model for eruptive binaries, period variations, properties of the components and circumstellar matter, theories and hypotheses concerning variability, and other objects which are related to the eruptive binaries are considered. (IAA)

25433 VARIABLE STAR OBSERVATIONS FROM OUTSIDE THE EARTH'S ATMOSPHERE: REVIEW AND PROSPECTS. Kondo, Y. Int. Astron. Union Symp.; No. 15, 298-307(1971).

From 5th conference on variable stars; Bamberg, Germany (31 Aug 1971).

This discussion of the variable star observations is restricted primarily to the uv region of the electromagnetic spectrum with brief comment on other spectral regions when appropriate. An attempt is made to enumerate some of the reasons why uv observations of the variable stars are of serious interest. Accurate observations of eclipsing variables are essential for general understanding of the stellar masses and radii, the mass luminosity relation, limb darkening, and for constructing realistic stellar models, particularly for early type stars. Previous and current experiments, and experiments planned for the future which make use of the ultraviolet, x rays and gamma rays, and the infrared are discussed. Brief mention is made of future radio experiments. (IAA)

25434 OAO-2 OBSERVATIONS OF BETA LYRAE AND A PROVISIONAL INTERPRETATION. Kondo, Y.; McCluskey, G. E. Jr.; Houck, T. E. Int. Astron. Union Symp.; No. 15, 308-313(1971).

From 5th conference on variable stars; Bamberg, Germany (31 Aug 1971).

Six-color ultraviolet photoelectric observations of beta Lyrae obtained with OAO-2 are presented. These observations, made at 1380, 1500, 1920, 2460, 2980, and 3330 A, represent the first truly continual coverage of the light changes of beta Lyrae during one orbital revolution and were obtained in November 1970. The photometric data are supplemented by spectral scans in the wavelength intervals 3800 to 1800 A and 2000 to 1050 A; the latter interval was scanned at 10 A resolution once during every OAO-2 orbit, i.e., about 100 minutes. Anomalous features, such as asymmetries and short and long term variations, are present in the light curves. A tentative discussion of solutions of the light curves is given. (auth)

Quasi-Stellar, Radio, and X-Ray Sources

Refer also to abstracts 25343 and 26393.

25435 (AD-756464) RADIO AND OPTICAL ACTIVITY OF THE PECULIAR OBJECT BL LAC (VRO 42.22.01) AND 3.3-MM OBSERVATIONS OF CYGNUS X-3. Report for February 1968–July 1972. Epstein, E. E.; Pomphrey, R. B.; Hackney, R. L.; Hackney, K. R.; Smith, A. G. (Aerospace Corp., El Segundo, Calif.). 15 Jan 1973. Contract F04701-72-C-0073. 21p. (SAMSO-TR-72-303). NTIS.

In late 1971, BL Lac underwent an isolated optical flare of a type previously observed in optically violent (OVV) quasars. Although this event was followed in 55 days by a similar radio flare, an examination of all available data indicates that the observations cannot be correlated by the assumption of a constant radio-optical delay. The 3-mm measurements of the giant radio outburst of Cygnus X-3 during early September 1972 are presented. (auth) (NTIS)

25436 LONG-TERM BEHAVIOUR OF HERCULES X-1. Fabian, A. C.; Pringle, J. E.; Rees, M. J. (University Coll., London). Nature (London); 244: No. 5413, 212-213(27 Jul 1973).

Observations of Her X-1 made with the Copernicus satellite x-ray detectors on June 5, 1973 are reported. The purpose of the observations was to search for the hypothetical steady soft component. An unexpected result was that Her X-1 was detected in the 4 to 12 keV channel at an intensity comparable with the previously measured "high state" intensity. The observations provided no evidence for a steady soft x-ray flux strong enough to heat the companion star. (UK)

25437 NEW HIGH-ENERGY SOURCES IN THE UNIVERSE. Radiogalaxies, Quasars, and Pulsars. Priester, W. (Univ., Bonn). (1973). vp. (In German).

From reactor meeting; Karlsruhe, Germany (10 Apr 1973).

The paper deals with pulsars producing high-energy electrons (e.g. the Crab pulsar) and with high-energy particles as the primary carriers of energy in quasars and radiogalaxies (including the question of quasars as place of birth of new matter, "quarks", R. Oppenheimer), as well as with the "super-pulsar-mechanism" of Morrison. (GE)

25438 SOME IDENTIFICATIONS OF RADIO SOURCES WITH NEUTRAL STELLAR OBJECTS. Browne, I. W. A.; Crowther, J. H.; Adgie, R. L. (Nuffield Radio Astronomy Labs., Jodrell Bank, Eng.). Nature (London); 244: No. 5412, 146-149(20 Jul 1973).

Twenty-four identifications of radio sources with neutral-colored objects of stellar appearance are described. These objects are considered to be of special interest since they do not fall into the two normally accepted categories for identification—galaxies or blue stellar objects. Two of them have also exceptionally high redshifts. The identifications are based on radio positions measured with the RRE interferometer and optical positions measured from points of the Palomar Sky Survey. Positions and optical magnitudes of the sources are shown

tabulated, and finding charts for all the objects are reproduced. It was interesting that, of the sources examined, those with flat peaked, or inverted radio spectra gave the highest yield of identifications with neutral stellar objects, leading to the probability that the radio emission from those sources comes from very compact regions, and may well be variable. (UK)

25439 EXTRAGALACTIC RADIO PHENOMENA. Bolton, J. G. (Australian National Radio Astronomy Observatory, Parkes). pp 111-124 of 12th International Conference on Cosmic Rays. Hobart, Australia; International Union of Pure and Applied Physics (1971).

From 12th international conference on cosmic rays; Hobart. Australia (16 Aug 1971).

It is shown that the slope of the number–flux density relation for radio sources is a function of the survey frequency, which appears to be due to the effect of a change in the number–flux density relation with the spectral index. Measurements were made at 2700 MHz over an area of over 5000 square degrees in three investigations: 1) for 4C sources in the −4° to 20° declination zone; 2) for sources in the Parkes 2700 MHz declination catalogue for declination zone ±4° which overlaps the 4C catalogue; and 3) flux densities were measured at 5000 MHz. (AT)

25440 GAMMA-RAY ASTRONOMY. Frye, G. M. Jr. (Case Western Reserve Univ., Cleveland). pp 145-160 of 12th International Conference on Cosmic Rays. Hobart, Australia; International Union of Pure and Applied Physics (1971).

From 12th international conference on cosmic rays; Hobart, Australia (16 Aug 1971).

A review of γ-astronomy developments is made and relevant papers presented at the conference are interpreted, in the energy regions E_γ = 1 to 50 MeV (particularly with reference to the Crab Nebula), $E_\gamma > 50$ MeV, and $E_\gamma > 10^{11}$ eV. Tentative identifications of γ sources have correlated two with the x-ray objects GX1 + 4 and GX340 + 0 (both presumably galactic) and two with 3C 120 and PKS 1514-24 which are extragalactic. (AT)

25441 MACROSCOPIC PARAMETERS OF QUASAR NUCLEI ESTIMATED FROM THE THERMAL COMPONENT OF THE CONTINUUM. Ozernoi, L. M. (Lebedev Physics Institute, Academy of Sciences of the USSR). Sov. Astron.–AJ 16: No. 5, 916-917 (Mar 1973).

The quasi-Planck component of the optical continuum of quasars, which according to Grewing and Lamla remains after a power-law synchrotron component has been removed, evidently arises from the thermal radiation of a supermassive body. A rough estimate for the mass and radius of this body is consistent with the expected parameters of a magnetoid. (auth)

25442 RADIO-BRIGHTNESS DISTRIBUTION OVER THE CRAB NEBULA AT 3.55 AND 1.28 CM. Matveenko, L. I.; Meeks, M. L. (Institute for Space Research, Academy of Sciences of the USSR, Moscow Haystack Observatory, Westford, Massachusetts). Sov. Astron.–AJ 16: No. 5, 790-794 (Mar 1973).

The brightness distribution in the Crab Nebula at wavelengths of 3.55 and 1.28 cm has been determined with the 64-m Goldstone and 37-m Haystack radio telescopes, respectively. At 1.28 cm the flux density is 495±25 f.u., with (7.7±0.6) % polarization in position angle 155°±3°. (auth)

25443 DEPOLARIZATION OF SYNCHROTRON RADIATION IN VARIOUS SOURCES. Sazonov, V. N. (Lebedev Physics Institute, Academy of Sciences of the USSR, Moscrow Technical Physics Institute). Sov. Astron.–AJ 16: No. 5, 774-781 (Mar 1973).

The frequency dependence of the degree of linear polarization is calculated for various model sources. The inhomogeneous distribution of relativistic electrons and cool magnetoactive plasma in the source and the nonuniform length of the source along the line of sight in different directions are taken into account. At low frequencies, where Faraday rotation in the source is important, the percentage polariztion may decrease with diminishing frequency either more rapidly or more slowly than by the ν^2 law obtained for the simplest models. In particular, a slower decrease is found if the relativistic electrons are distributed more homogeneously over the source than the cool plasma. In some of the models the position angle for low-frequency radiation is independent of frequency, despite strong Faraday rotation inside the source and the resulting depolarization of the radiation. The calculations are compared with polarimetric observations of radio sources (mainly extragalactic) in 1964–1969, and an interpretation is offered. Possible inferences as to the properties of the sources are discussed. Polarization measurements could yield evidence for a halo or a two-component structure in a radio source, even if the angular size of the source is below the resolution limit. As an illustration, the rotation measure and electron density in the halo of the source 0637–75 are calculated. (auth)

25444 OBSERVATIONS OF RADIO SOURCES AT SHORT MILLIMETER WAVELENGTHS. Zabolotnyi, V. F.; Moiseev, I. G.; Pavlov, A. V.; Slysh, V. I.; Soglasnova, V. A.; (and others) (Shternberg Astronomical Institute, Moscow). Sov. Astron.–AJ 16: No. 5, 795-802 (Mar 1973).

During 1969–1970 observations were made at the short-wave end of the millimeter range, using the 22-m radio telescope of the Crimean Astrophysical Observatory and a wideband radiometer with an InSb detector cooled by liquid helium. The beamwidth was 2.0 at the half-power level. The flux density or an upper limit has been measured for 12 galactic and extragalactic sources. (auth)

25445 OBSERVATIONS OF QUASISTELLAR OBJECTS AT 7700 MHZ. Lipovka, N. M. Sov. Astron.–AJ 16: No. 5, 803-805 (Mar 1973).

Observations of radio sources having a flat spectrum are reported. Optical identifications suggest that most of the objects identified are associated with quasars. Most objects have a complex structure and are radiovariable; two (NRAO 140 and 2134+000) appear to be optically variable. (auth)

25446 HUBBLE DIAGRAMS FOR QUASARS. Setti, G. (Laboratorio di Radio astronomia, Bologna, Italy); Woltjer, L. Astrophys. J. Lett. 181: No. 2, L61-L63 (15 Apr 1973).

Quasars are subdivided into several groups. Those whose radio characteristics resemble the strong radio galaxies are found to show a clear Hubble relation. (auth)

25447 BLACK HOLES AND ABSORPTION REDSHIFTS IN QUASI-STELLAR OBJECTS. Mashhoon, B. (Joseph Henry Laboratories, Princeton University). Astrophys. J. Lett. 181: No. 2, L65-L69 (15 Apr 1973).

On the basis of the possible existence of black holes in galactic nuclei, the jet mechanism proposed by Wheeler is used to explain the absorption redshifts in QSOs. (auth)

25448 OAO-2 OBSERVATIONS OF HD 153919=2U 1700-37. Heap, S. R. (Laboratory for Optical Astronomy, Goddard Space Flight Center, NASA,). Astrophys. J. Lett. 181: No. 2, L71-L73 (15 Apr 1973).

HD 153919, an O7f star recently proposed as the optical identification of the X-ray source 2U 1700-37, was monitored with the Wisconsin experiment on OAO-2 in 1972 September. These observations indicate that HD 153919 is optically a variable. (auth)

25449 THE REFLECTION EFFECT IN HZ HERCULIS. Wilson, R. E. (Institute for Space Studies, New York, N.Y.). Astrophys. J. Lett. 181: No. 2, L75-L77 (15 Apr 1973).

The theoretical phase law for the reflection effect is not in agreement with the photometric observations of HZ Her. The discrepancy may be explained by transfer of energy from the irradiated side of the optical component to the side facing away from the X-ray source. This transfer must involve a significant fraction of the envelope of the optical component, and is in accord with recently developed ideas on the behavior of irradiated convective envelopes. (auth)

25450 VARIABLE X-RAY SOURCES. Kellogg, E. M. Int. Astron. Union Symp.; No. 15, 168-172(1971).

The behavior of the quasi-periodic rapid variable Cyg X-1, the periodic variable Cen X-3, and the aperiodic variable Sco X-1 is described. Observations of Cyg X-1 were made by pointing the Uhuru satellite to a position where the object was in the band visible to the x-ray detectors; observations were also obtained by other methods. It appears that the x-ray emitting region is a few light sec in size, and some of the fast variations originate in a region as small as several R_E in size. It is believed at present that a pulsating white dwarf could explain the x-ray behavior of Cen X-3. X-ray data from Sco X-1 reveal that it behaves in soft x rays much as it is well known to do in visible light. (IAA)

25451 INTERPLANETARY-SCINTILLATION OBSERVATIONS OF 203 SOURCES IDENTIFIED AS RADIO GALAXIES OR QUASARS. Harris, D. E. (Harvard College Observatory, Cambridge, Massachusetts). Astron. J. 78: No. 5, 369-375 (June 1973).

Optically identified radio sources have been observed to determine the presence of any small-diameter components. The data, which were obtained at the Arecibo Observatory at 318 and 430 MHz, emphasize the statistical differences between quasars and radio galaxies and demonstrate a correlation between redshift and scintillation visibility for quasars. (auth)

25452 QSO HISTORICAL LIGHT CURVES. Angione, R. J. (The University of Texas at Austin, Austin, Texas). Astron. J. 78: No. 5, 353-368 (June 1973).

Optical variability of 20 QSO's and three Seyfert or Seyfert-like galaxies has been studied based on light curves obtained from the

Harvard historical plate collection. Individual light curves are presented along with discussion of their interpretation. Each of these 23 objects, selected solely because of apparent brightness, is found to be optically variable. The variations range from barely detectable ($\sigma > 0.13$ mag) to over two magnitudes. Correlation of the amplitude of variation with a measure of the intrinsic luminosity (assuming cosmological redshift) gives a relation very nearly that expected if each QSO consisted of an assemblage of randomly varying sources: the smaller the amplitude, the brighter the object. However, several objects appear to have exhibited systematic trends or quasi-periodicity with a time scale of ten to twenty years. Also, power spectra are not consistent with simple stochastic models, and some of the details of certain light curves seem to require a single small source for most of the light. (auth)

25453 PHOTOMETRIC STUDY OF BL LACERTAE. II. BIS–B and V Magnitudes During the Period March 1969–January 1971 and Bibliographic Informations. Bertaud, C. (Observatoire de Meudon, France); Wlerick, G.; Veron, P.; Dumortier, B.; Duruy, M.; de Saevsky, P. Astron. Astrophys., Suppl. Ser.; 11: No. 1, 77-92(Jul 1973). (In French).

In a recent paper (paper II, Bertaud et al., 1973), the light curve of BL Lacertae was shown, in the B color, for the period March 1969–January 1971 and the properties of the flux variations were discussed. The tables of the B and V magnitudes used to construct the light curve are presented. To facilitate the study of the photometric variations, a table was prepared that includes the publications concerning the light variations of this object in the visible. (auth)

25454 HZ HERCULIS: THE SONNEBERGER X-RAY STAR. Kippenhahn, R. Sterne Weltraum; 12: 133-136(May 1973). (In German).

A periodically pulsating double-star x-ray source in the constellation Hercules was discovered with the aid of the satellite Uhuru. A mean interval of 1.24 seconds between x-ray pulses was observed. The observations indicate that a body emitting brief pulses orbits another celestial body. The x-ray signal is not received at regular intervals of 1.70017 days. Questions of optical identification are discussed together with the significance of x-ray emission and a model of the x-ray star. (IAA)

25455 MOLONGLO RADIO SOURCE CATALOGUE. 1. Davies, I. M.; Little, A. G.; Mills, B. Y. (Univ., Sydney). Aust. J. Phys., Astrophys. Suppl.; No. 28, 1-59(Aug 1973).

A catalogue of radio sources observed at a frequency of 408 MHz with the Molonglo radiotelescope is presented. The catalogue includes an area of 0.21 sr between declinations –19.3 and –22.4°. A total of 1545 sources is listed down to a limiting flux density of 0.1 f.u., the catalogue being largely complete above 0.25 f.u. Errors in position vary from ~5″ arc for sources stronger than 1 f.u. to ~30″ arc for the weakest sources. (auth)

25456 HIGH-FREQUENCY OBSERVATIONS OF THE RADIO SOURCE NRAO 530. Welch, W. J.; Spinrad, H. (Univ. of California, Berkeley). Publ. Astron. Soc. Pac.; 85: No. 506, 456-457 (Aug 1973).

NRAO 530 is a somewhat variable, almost flat-spectrum radio source. Hat Creek flux measures extend the radio spectrum to 22.3 GHz. The flux density at this frequency is 3.9 f.u. It is identified as a QSO, on the basis of the astrometry of Kristian and Sandage (1970) and a new blue photograph. (auth)

Solar Phenomena

Refer also to abstracts 24519, 25416, 25557, 25564, 25625, and 26376.

25457 (AD-756220) SHORT-DURATION SOLAR MICROWAVE BURSTS AND ASSOCIATED SOFT X-RAY EMISSION. Spangler, S. R. (Iowa Univ., Iowa City. Dept. of Physics and Astronomy). Dec 1972. Contract N00014-68-A-0196-0003. 105p. NTIS.

The purpose of this study is to investigate the characteristics of short-duration microwave flares and their association with soft (2 to 12 A) x-ray emission, and to discuss conclusions concerning the solar flare process which may be inferred from the observations. Some of the experimental areas investigated or commented upon are as follows: correlation between microwave and soft x-ray events, possibility of classes of short-duration microwave bursts, investigation of time morphologies of correlated x-ray and radio bursts, and intensity and energy relationships in associated radio and x-ray events. (NTIS)

25458 (AD-756501) VALIDITY OF CGL EQUATIONS IN SOLAR WIND PROBLEMS. Schulz, M.; Eviatar, A. (Aerospace Corp., El Segundo, Calif.). 31 Jan 1973. Contract F04701-72-C-0073. 19p. (SAMSO-TR-73-44). NTIS.

The double-adiabatic equations of state are derived algebraically from Liouville's theorem for an azimuthally symmetric proton exosphere throughout which the bulk velocity greatly exceeds the proton thermal velocities. The calculated skewing of the distribution function f (v) in the solar exosphere is found to agree qualitatively with observation and with the direction of heat flow inferred from dell T parallel. (auth) (NTIS)

25459 (AD-756827) SOLAR ACTIVITY IN McMATH REGION 10789 DURING DISK PASSAGE, 12–15 June 1970. Carrigan, A. L.; Castelli, J. P. (Air Force Cambridge Research Labs., L. G. Hanscom Field, Mass.). 16 Nov 1972. 30p. (AFCRL-PSRP-528; AFCRL-72-669). NTIS.

Less than half a dozen longitude-identified active regions in the (current) 20th sunspot cycle produced 90 or more solar eruptions during disk passage. Besides a high flare-burst productivity, each of these was identified with energetic particle emission. A recent one of these regions was centered around longitude 226 degrees (17 degrees N latitude) in McMath region 10789, with central meridian passage on 16.8 June 1970. It is shown that the region which spawned an unusually high burst-to-flare ratio on 13 June had the maximum radio brightness at both 10.7 and 20 cm lambda in this brief interval. (NTIS)

25460 (AD-756924) MEASUREMENTS OF GALACTIC COSMIC-RAY DOSE AND GEOMAGNETICALLY TRAPPED RADIATION FROM THE OV1-4 SATELLITE. Kopf, C. (Air Force Weapons Lab., Kirtland AFB, N. Mex.). Feb 1973. 29p. (AFWL-TR-720187). NTIS.

A highly sensitive tissue-equivalent ionization chamber was flown aboard the OV1-4 satellite, which was launched on March 30, 1966. The orbit was roughly circular with an apogee of 1019 kilometers and a perigee of 893 kilometers. The complete results from the ionization chamber are presented in geographic coordinates and geomagnetic B-L coordinates. Galactic cosmic ray and geomagnetically trapped dose rates were measured. (auth) (NTIS)

25461 (AD-760124) SOLAR ACTIVE REGIONS AND ASSOCIATED PHENOMENA. Final Report, 1 May–31 December 1972. Howard, R. F. (Hale Observatories, Pasadena, Calif.). 30 Jan 1973. Contract F19628-72-C-0208. 9p. (AFCRL-TR-73-120). NTIS.

More than 275 full-disk scans of the solar surface were made at the Mount Wilson Observatory in several spectrum lines. Analysis of the resulting velocity signals indicates that although the equatorial velocities measured with the FeI and FeII lines are identical, the high-latitude rotations differ. The ionized line shows a more rapid falloff of angular velocity with latitude than does the neutral line. This is an exciting and unexpected result that will be studied in more detail. The limb redshift parameters from the two lines differ by nearly a factor two, with the ionized line having the larger value. Variations with time in the equatorial velocities measured with the two lines were nearly the same. The average equatorial velocities over the observing period were significantly faster than for a comparable period five years ago. This may be associated with a lower level of solar activity. (auth) (NTIS)

25462 (N-73-14808) CORRELATIVE STUDIES OF THE SOLAR WIND. The Interplanetary Magnetic Field, and Their Effects on the Geomagnetic Cavity Using Explorer 33 and 35 Data. Final Report. Coleman, P. J. Jr. (California Univ., Los Angeles (USA). Space Science Center). 9 Aug 1972. 13p. (NASA-CR-129924). NTIS.

The work completed in the study of the effects of the solar wind and interplanetary magnetic field on the bow shock and geomagnetic cavity is reported along with work underway but not yet completed. The correlative data from Explorer 33 and 35, and the computer programs for processing the data are described. The research discussed includes: polar cusps, substorms, geomagnetic activity, and north–south component of the interplanetary magnetic field. Lists of publications, and papers presented at meetings are included. (STAR)

25463 INTERPLANETARY GAS DYNAMICS. Liu, V. C. (Univ. of Michigan, Ann Arbor). Advan. Appl. Mech.; 12: 195-237(1972).

Observations of the interplanetary medium are considered together with the structure of the solar atmosphere and the kinetic properties of the interplanetary plasma. Methods of gas kinetics and continuum flows are examined, taking into account microscopic and macroscopic representations, the kinetic flow equations, the formal solution of the Vlasov equation, and the continuum flow equations. The collective particle behavior of that interplanetary gas is discussed along with the hydrodynamic coronal expansion, a wave-pump problem, the free expansion phenomenon, and a generalized free expansion problem. (IAA)

25464 MULTIDIRECTIONAL SCANNING OF ACTIVE REGIONS WITH A SLIT-JAW SPECTROGRAPH AND A SOLAR CHROMATOGRAPH. I. Description of the Method and Some Preliminary Results for the Flare Event of August 4th 1972. Kusoffsky, U. (Swedish Astrophysical Station, Anacapri, Italy); Palsgard, G. Solar Phys.; 30: No. 1, 121-127 (May 1973).

At the Swedish Solar Observatory in Anacapri the following combination of instruments was used in an investigation of active regions: (1) A spectrograph with an image rotator placed in front of the slit. (2) A subtractive double dispersive spectrograph (solar chromatograph). (3) A Hα ± 0.5 Å patrol instrument. Scans over the 3b flare of August 4, 1972 were used to illustrate the method. The illustrations clearly showed downflowing matter connected with bright knots and filaments in the emitting area, possibly in accordance with Hyder's infall-impact mechanism. (auth)

25465 LIMB FLARE OF AUGUST 11, 1972. Waldmeier, M. (Swiss Federal Observatory, Zurich). Solar Phys.; 30: No. 1, 129-137 (May 1973).

A limb flare is described that occurred above a complex and very active sunspot. Four stages can be distinguished: the flash-phase, the spray-phase, the surge-phase, and the loop-phase. Each of them had a duration that was longer than that of the preceding one. In the spray ascending speeds up to 745 km s^{-1} and accelerations up to 1.3 km s^{-2} were recorded. The loop-phase has been observed in the coronal lines 5303 and 5694 Å. The yellow line, being very weak before the flare, became extremely strong in the loop and surpassed five times the intensity of the green line. X-ray bursts and ionospheric disturbances of long duration demonstrate that not only the flare itself but also the loop was a source of x rays. Most of the radio-bursts can be ascribed to specific features in the Hα-records of the event. (auth)

25466 POSSIBLE MECHANISM OF SURGE FORMATION IN THE SOLAR ATMOSPHERE. Platov, Yu. V. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio-Wave Propagation, Moscow); Somov, B. V.; Syrovatskii, S. I. Solar Phys.; 30: No. 1, 139-147 (May 1973).

The possibility of surge formation as a result of plasma "raking-up", the latter being associated with the growth of the local magnetic field in the solar atmosphere, is considered. The question is treated numerically in the MHD approximation for the case of the dipolar magnetic field. It is shown that the field growth results in the appearance of relatively dense condensations stretched along the axis of a dipole. Simultaneously the plasma acquires the upward velocity along force lines which leads to the formation of a surge. Some properties of this surge model are discussed. (auth)

25467 CORRELATION AND SPECTRAL ANALYSIS OF DAILY SOLAR RADIO FLUX. El-Raey, M. (Univ. of California, Berkeley); Scherrer, P. Solar Phys.; 30: No. 1, 149-158 (May 1973).

Correlation and spectral analysis of solar radio flux density and sunspot number near the maximum of the sunspot cycle has indicated the existence of (a) long period amplitude modulation of the slowly varying component (SVC) of radio emission; (b) coronal storage over a period of the order of three solar rotations; (c) fast decay (one solar rotation period or less) of gyromagnetic emissions from radio sources; (d) shift in location of chromospheric sources compared to those of either the upper corona or the photosphere. (auth)

25468 POLARIZATION INVERSIONS IN THE RADIO EMISSION AT 237 MHz OF McMATH ZONE 11482. Santin, P. (Astronomical Observatory, Trieste, Italy). Solar Phys.; 30: No. 1, 159-161 (May 1973).

The emission at 237 MHz of the activity center located in the McMath zone 11482 during its passage on the solar disc, from August 17 to 31, 1971, is reported. During this period it was practically the only active group from the radio point of view. (WDM)

25469 SOURCE OF THE SLOWLY VARYING COMPONENT AT CENTIMETER AND MILLIMETER WAVELENGTHS. Shimabukuro, F. I. (Aerospace Corp., El Segundo, CA); Chapman, G. A.; Mayfield, E. B.; Edelson, S. Solar Phys.; 30: No. 1, 163-173 (May 1973).

The general features of the slowly varying component at centimeter and millimeter wavelengths are explained by magneto-ionic thermal emission. A model of an active region is constructed in which the electron temperature and density profile is based on recent euv measurements, and the current-free magnetic-field configuration is derived from a longitudinal magnetogram and scalar potential theory. In the model, the contributions of the reflected component of the inward extraordinary wave is important in determining the characteristic features of the radio flux and polarization. Emission by the mechanism of resonance absorption does not appear to be a significant factor in this model. (auth)

25470 DECAY TIME OF TYPE III SOLAR BURSTS OBSERVED AT KILOMETRIC WAVELENGTHS. Alvarez, H.; Haddock, F. T. (Univ. of Michigan, Ann Arbor). Solar Phys.; 30: No. 1, 175-182 (May 1973).

Type III bursts were observed between 3.5 MHz and 50 kHz by the University of Michigan radio astronomy experiment aboard the OGO-5 satellite. Decay times were measured and then combined with published data ranging up to about 200 MHz. The observed decay times increase with decreasing frequency but at a rate considerably slower than that expected from electron–proton Coulomb collisions. At 50 kHz values differ by about a factor of 100. Using Hartle and Sturrock's solar-wind model, Coulomb collisional frequencies were computed and compared with the apparent collisional frequencies deduced from the observations. It was found that the ratio of observed to computed values varies with heliocentric distance according to an inverse 0.71 power. This is similar to an ad hoc function used by Wolff, Brandt, and Southwick to increase the electron–proton collisional energy exchange and make the solar-wind theory agree with the measurements of electron and proton temperature near the Earth. These results may provide a clue about the nature of the noncollisional plasma wave damping process responsible for the short duration of Type III bursts. (auth)

25471 UPPER LIMIT TO THE 1 TO 20 MeV SOLAR NEUTRON FLUX. Lockwood, J. A.; Ifedili, S. O.; Jenkins, R. W. (Univ. of New Hampshire, Durham). Solar Phys.; 30: No. 1, 183-191 (May 1973).

The upper limit on the quiet time solar neutron flux from 1 to 20 MeV was measured to be less than 2×10^{-3} n cm^{-2} s^{-1} at the 95% confidence level. This result was deduced from the OGO-6 neutron detector measurements of the "day–night" effect near the equator at low altitudes for the period from June 7, 1969, to December 23, 1969. The OGO-6 detector had very low (<4%) counting rate contributions from locally produced neutrons in the detecting system and the spacecraft and from charged-particle interactions in the neutron sensor. (auth)

25472 NONTHERMAL SOLAR WIND HEATING BY SUPRATHERMAL IONS. Fahr, H. J. (Institut fuer Astrophysik und Extraterrestrische Forschung, Bonn). Solar Phys.; 30: No. 1, 193-206 (May 1973).

The effect of a new energy source due to energies transferred from supra-thermal secondary ions on the temperature profile of the solar wind is considered. For this purpose a solution of a tri-fluid model of the solar wind including solar electrons, protons, and α particles, and starting with the boundary conditions of Hartle and Barnes at 0.5 AU is given. On the base of the assumption that suprathermal He^+-ions which have four times the temperature of suprathermal protons are predominantly coupled to solar α particles by Alfvén waves, it is shown that the temperature T_α of solar α particles should be appreciably higher than those T_p of solar protons beyond the orbit of the Earth. For 1 AU a temperature excess T_α over T_p according to that which has been found in some solar-wind ion spectrograms can only be explained for a small part of the orbit of the Earth which is inside the cone of enhanced helium densities. Around 1 AU the temperatures T_α and T_p are found to decrease much slighter with solar distance than given in the two-fluid model of Hartle and Barnes. Beyond 1.7 and 2.2 AU the temperatures T_α and T_p even start increasing with solar distance and come up to about 10^5 at about 10 AU. These predictions should lend some support to future temperature measurements with deep-space probes reaching solar distances of some AU. (auth)

25473 VARIATIONS OF α-PARTICLE ABUNDANCE IN THE SOLAR WIND. Moreno, G.; Palmiotto, F. (Univ., Rome). Solar Phys.; 30: No. 1, 207-210 (May 1973).

The HEOS-1 observations of the α-particle abundance in the solar wind are compared with vela 3A and 3B data. The evidence seems to favor the Nakada model. (WDM)

25474 SOLAR WIND INTERACTION WITH COMET BENNETT (1969i). Burlaga, L. F. (Goddard Space Flight Center, Greenbelt, MD); Rahe, H.; Donn, B.; Neugebauer, M. Solar Phys.; 30: No. 1, 211-222 (May 1973).

The relations between the solar wind and Comet Bennett during the period March 23 to April 5, 1970 are examined. A large kink was observed in the ion tail of the comet on April 4, but no solar-wind stream was observed in the ecliptic plane which could have caused the kink. Thus, either there was no correlation between the solar wind at the Earth and that at Comet Bennett (which was 40° above the ecliptic) or the kink was caused by something other than a high-speed stream. The fine structure visible in photographs of the kink favors the second of these alternatives. It is shown that a shock probably passed through Comet Bennett on March 31, but no effect was seen in photographs of the comet. A stream preceded by another shock and a large abrupt change in momentum flux might have intercepted the comet between March 24 and March 28, but

again no effect was seen in photographs of the Comet. In view of these results, one must seriously consider the possibility that a large, abrupt change in momentum flux of the solar wind (such as that at a shock wave or ahead of a stream) is neither necessary nor sufficient to cause a large kink in a comet tail. (auth)

25475 SOLAR-WIND PROPERTIES AT THE EARTH AS PREDICTED BY THE TWO-FLUID MODEL. Durney, B. R. (National Center for Atmospheric Research, Boulder, CO). Solar Phys.; 30: No. 1, 223-234 (May 1973).

The two-fluid equations for the solar wind are written down in a simplified form, similar to that suggested by Roberts (1971) for the one-fluid model. The equations are shown to depend only on one parameter, $K = GM\kappa_e m_p(\epsilon \propto T_0)^{\frac{5}{2}}/4k^2F_e$, where G is the gravitational constant, M the mass of the star, κ_e the thermal electron conductivity, m_p the proton mass, k the Boltzmann constant, $k\epsilon \propto T_0$ the residual energy per particle at infinity and F_e the electron-particle flux. For a variety of values of the density and temperature at the base of the corona the solutions of the two-fluid solar-wind model are computed and the predicted and observed solar-wind parameters at the Earth are compared. (auth)

25476 ENERGY LOSSES OF SOLAR COSMIC RAYS IN INTERPLANETARY SPACE. Palmer, I. D. (Los Alamos Scientific Lab., NM). Solar Phys.; 30: No. 1, 235-242 (May 1973).

A simple model of solar cosmic-ray propagation which includes diffusion, convection, and energy loss by adiabatic deceleration is studied. A Monte Carlo technique is employed to investigate the variation of mean particle energy in the interplanetary medium after the impulsive release of monoenergetic particles at the Sun. At 1 AU typical energy losses are 43% at 20 h and 64% at 60 h after particle release for a diffusion coefficient $\kappa(r) = \kappa_0 r^\beta$ with $\beta = +1\frac{1}{2}$ and $\kappa_0 = 1.33 \times 10^{21}$ cm^2 s^{-1}. When κ_0 in this model is reduced by a factor of 4, the energy loss is greater by a factor of 2 at 60 h after particle release. When β is increased, the energy losses are greater. Using the model parameters above, an increase in solar wind speed from 300 to 600 km s^{-1} gives rise to energy losses that are greater again by factor of 2 at a time of 60 h. Results are compared with an observation by Murray et al. (1971) of a "knee" in the energy spectrum of solar protons. It is not considered likely that the change in the energy of the knee with time requires, in addition to adiabatic deceleration, another energy change process which acts to increase the energy of particles. (auth)

25477 EVIDENCE FOR CONFINEMENT OF LOW-ENERGY COSMIC RAYS AHEAD OF INTERPLANETARY SHOCK WAVES. Palmeira, R. A. R.; Allum, F. R. (Univ. of Texas, Dallas). Solar Phys.; 30: No. 1, 243-253 (May 1973).

Short-lived (~15 min), low-energy proton increases associated with the passage of interplanetary shock waves have been previously reported. An examination was made in a fine time scale (~1 min) of the concurrent particle and magnetic field data, taken by detectors on Explorer 34, for four of these events which occurred on May 30, 1967, June 5, 1967, November 29, 1967, and January 11, 1968. The results further support the view that these impulsive events are due to confinement of the solar cosmic-ray particles in the region just ahead (~10^6 km) of the advancing shock front. Data from the Pioneer 7 spacecraft for a similar event on August 30, 1966, when this spacecraft was 1.9×10^6 km from the Earth, are shown to be consistent with this interpretation. (auth)

25478 FIRST OBSERVATIONS OF THE GRANULATION AT 1.65μ, CENTER TO LIMB VARIATION OF THE CONTRAST. Turon, P. J.; Lena, P. (Observatoire de Paris, Meudon, France). Solar Phys.; 30: No. 1, 3-14 (May 1973).

Brightness fluctuations at 1.65μ were recorded by means of a 64-element array. Infrared photographs clearly showed sunspots and granulation with a resolution better than 1''. Quantitative analysis of the digitized data was used to compute autocorrelation and power spectrum. Half-width of autocorrelation (405 km) indicated a resolution comparable with the best observations in the visible range. Photographs and quantitative analysis showed the existence of a strong contrast variation from the center to the limb. Seeing and instrumental effects are discussed. A model M. T. F. was utilized to compute a foreshortening correction. No attempt was made to get the actual absolute rms value. Nevertheless a definite variation of the observed rms which goes from 1.48% ± 0.15, at the center, to 1.05% ± 0.15 at $\mu = 0.7$ (after foreshortening correction) was found. (auth)

25479 STATISTICAL ANALYSIS OF A SOLAR GRANULATION PLATE. Aime, C. (Nice Univ.). Solar Phys.; 30: No. 1, 15-18 (May 1973).

Two-dimensional autocorrelation function and power spectrum per unit area are given for a solar granulation plate taken at the Pic-du-Midi Observatory. A comparison is made between the result and the power per unit wave number taken from the Schwarzschild stratoscope data. (auth)

25480 STUDIES OF GRANULAR VELOCITIES. III. The Influence of Finite Spectral and Spatial Resolution upon the Measurement of Granular Doppler Shifts. Mehltretter, J. P. (Sacramento Peak Observatory, Sunspot, NM). Solar Phys.; 30: No. 1, 19-28 May 1973).

The process of measuring granular velocity fields with an instrument having finite spectral and spatial resolution is investigated for the case that (1) a weak Fraunhofer line is used, (2) the velocity is constant with height in the solar atmosphere, (3) the original Doppler shifts are of the same order of magnitude as the "intrinsic" width of the line (width observed with infinitely high spectral and spatial resolution), (4) continuum brightness and line strength fluctuations are superimposed onto the velocity field. It is shown that using a spectral instrumental profile which is large compared to both the intrinsic line width and the rms Doppler shifts (as in the case of filtergrammes), the shift-induced brightness signal is always a linear function of the shift and corrections for finite spatial resolution can be applied to the measured shifts in the usual straightforward way. If the spectral instrumental profile is not large (as in the case of slit-spectrogrammes), the observed line profile is shown to depend upon the spatial resolution as well. It is altered (broadened, made asymmetric) by (1) spatially unresolved Doppler shifts and higher moments of the Doppler shift amplitude distribution, (2) by local correlation between continuum brightness, line strength, and velocity fluctuation. A value of the Doppler shift which is unaffected by nonlinearities, can be measured at a certain position in the line wing. Knowledge of the intrinsic line width is necessary, however, to determine this position, as well as the order of magnitude of the nonlinearity effects producing asymmetries in the observed line profile. Finally, the conditions are discussed under which a complete deconvolution of a spectrum could be accomplished. (auth)

25481 TEMPERATURE DIFFERENCE BETWEEN POLE AND EQUATOR OF THE SUN. Peraiah, A. (Tata Inst. of Fundamental Research, Bombay). Solar Phys.; 30: No. 1, 29-30 (May 1973).

In view of conflicting reports, an attempt is made to calculate the pole–equator difference using von Zeipel's (1924) law according to which the radiative flux of a rotationally of gravitationally distorted star is proportional to its surface gravity. (WDM)

25482 FORMATION OF MgI 4571 A IN THE SOLAR ATMOSPHERE. III. The Holweger Solar Model. Altrock, R. C. (Sacramento Peak Observatory, Sunspot, NM); Cannon, C. J. Solar Phys.; 30: No. 1, 31-33 (May 1973).

In Paper I of this series (Altrock and Cannon, 1972) a technique was introduced for analyzing the formation of MgI 4571 Å in the solar atmosphere. Due to the fact that no model was utilized with a temperature below 4140K for $\tau_{5000} < 10^{-4}$ it was decided to continue the analysis of Paper I with the Holweger (1967) model (T_e, N_e, N_H, ξ). (WDM)

25483 MICROTURBULENCE AND THE EFFECT OF DEPARTURES FROM LTE ON PHOTOSPHERIC IRON LINES. Holweger, H. (Univ., Kiel). Solar Phys.; 30: No. 1, 35-37 (May 1973).

It is shown that depth-dependent departures from LTE such as obtained by Athay and Lites (1972) will not notably affect the solar curve-of-growth of Fe I. This implies that both abundance and microturbulence may be determined from this curve-of-growth assuming LTE, and excludes that microturbulence is an artifact produced by non-LTE effects. (auth)

25484 IS THERE HORIZONTAL PHASE PROPAGATION OF 5-MIN OSCILLATIONS AT HIGH VELOCITIES. Deubner, F. L.; Hayashi, N. (Fraunhofer Inst., Freiburg i. B.). Solar Phys.; 30: No. 1, 39-46 (May 1973).

New observations of the photospheric 5-min oscillations are presented which prove that the physical reality of the very high horizontal phase propagation velocities observed in connection with the oscillations cannot be maintained. Instead, a statistical model is proposed to explain the observed phase relations. (auth)

25485 FIVE-MINUTE PERIOD OSCILLATION IN MAGNETICALLY ACTIVE REGIONS. Michalitsanos, A. G. (Cambridge Univ., Eng.). Solar Phys.; 30: No. 1, 47-61 (May 1973).

The magnetohydrodynamic frequency–wavelength relation, derived by McLellan and Winterberg (1968) was evaluated for an isothermal atmosphere. In particular, the effect which an inclined magnetic field and a finite horizontal wavelength have on the critical sonic and internal-gravity cut-off frequencies was examined, in which it was assumed that the magnetic field vector, wave vector, and gravity vector are coplanar. It is shown that the frequency band in which vertical wave propagation is impossible in the non-

magnetic photosphere, becomes smaller when an inclined uniform magnetic field is introduced, and that low frequency magnetically coupled internal-gravity waves do not propagate vertically if the horizontal wavelengths associated with this mode are greater than a critical wavelength which decreases with field strength. It is also demonstrated that an inclined magnetic field will inhibit the resonance that occurs at the critical frequency ω_g in the nonmagnetic atmosphere which is a result consistent with recent observations of the "wiggly line structure" in active regions. (auth)

25486 MORPHOLOGICAL STUDY OF SOLAR SPICULES. Lynch, D. K.; Beckers, J. M.; Dunn, R. B. (Sacramento Peak Observatory, Sunspot, NM). Solar Phys.; 30: No. 1, 63-70(May 1973).

From improved spicule filtergrams obtained with the Sacramento Peak vacuum telescope some spicule properties were measured. The spicule diameter of 950 km was well resolved. A small decrease of diameter with height was observed confirming older observations. The expansion of the spicule was found to be at least an order of magnitude less than reported by Mouradian. Spicule counts are very sensitive to the threshold intensity of the observations. Counts, and their dependence on threshold intensity, height, and wavelength are reported. (auth)

25487 SPECTROSCOPIC INVESTIGATION OF THE CHROMOSPHERE. III. Hα Line Profile From the Interior of Supergranular Cells. Grossmann-Doerth, U.; Von Uexkuell, M. (Fraunhofer Inst., Freiburg i. B.). Solar Phys.; 30: No. 1, 71-74(May 1973).

The line profile of Hα as emanating from the interior of supergranular cells was measured at $\sin\theta = 0$, 0.6, 0.8, and 0.9. The measurements are described and the results presented. (auth)

25488 POSSIBILITY OF CONSTRUCTING A RADIATIVE SUNSPOT MODEL IN MAGNETOHYDROSTATIC EQUILIBRIUM. Mullan, D. J. (Bartol Research Foundation of the Franklin Inst., Swarthmore, PA). Solar Phys.; 30: No. 1, 75-81(May 1973).

It is currently believed that it is impossible to construct a radiative sunspot model in magnetohydrostatic equilibrium unless magnetic fields below the surface are excessively large (>100 kG). This belief is based on results obtained using the mixing length theory of convection. It is pointed out that by using a different theory of convection, due to Öpik (1950), it is possible to compute a radiative sunspot model in which the field becomes no greater than 9000 G. By applying two boundary conditions, (i) depth of spot equals depth of convection zone, (ii) magnetic field has zero gradient at the base of the spot, it is shown that a radiative spot has a unique effective temperature for a given Wilson depression, Δ. For Δ = 650 km, T_e = 3800K; for Δ = 150 km, T_e = 3950K. According to the model, spots having T_e cooler than these values should not exist. (auth)

25489 CAN OSCILLATIONS GROW IN A SUNSPOT UMBRA. Mullan, D. J.; Yun, H. S. (Bartol Research Foundation of the Franklin Inst., Swarthmore, PA). Solar Phys.; 30: No. 1, 83-91 (May 1973).

Umbral flashes and running penumbral waves have been attributed by Moore (1972) to overstable oscillations in the umbra. His numerical results were derived by inserting physical conditions at two particular depths beneath the umbral surface. Seven variables must be specified at each point. Moore's analysis was extended to examine the depth-dependence of overstable oscillations in a recently computed umbral model. Electrical conductivity is evaluated taking full account of partial ionization and magnetic fields. In the surface layers, within 250 km of the top of the umbral convection zone, the conductivity is so low that Joule dissipation is more rapid than the growth rate of oscillations. In these layers, Moore's results are therefore not applicable. At greater depths, oscillations can grow and both umbral flashes and penumbral waves may be due to overstable oscillations. However, it is suggested that both phenomena can arise at the same depth in the spot, and not in two layers, as Moore suggests. The umbral model used is based on Öpik's cellular convection model. The interaction between the vertical magnetic field and convection is included by varying the diameter of the cell, and not its height. The diameter is assumed to be proportional to the distance that gas diffuses relative to the field during its upward convection. (auth)

25490 EAST–WEST ASYMMETRY IN THE NUMBER OF SPOT-GROUPS IN RELATION TO THEIR CLASSIFICATION. Bartsch, R. (Univ., Frankfurt am Main). Solar Phys.; 30: No. 1, 93-102(May 1973).

It is shown that the east–west asymmetry is quite different for spot-groups of different classes of evolution and that there exists a conspicuous difference between the ascending and descending branches with regard to the east–west asymmetry and the asymmetry between corresponding lunes. Some results point to the existence of systematic errors in the classification of the spot-groups. (auth)

25491 PERIODICITIES IN SOLAR ACTIVITY. Cole, T. W. (CSIRO, Sydney). Solar Phys.; 30: No. 1, 103-110(May 1973).

The techniques of power spectral analysis were used to determine significant periodicities in the annual mean relative sunspot numbers. The main conclusion was that a period of 10.45 yr is very basic and can be associated with an excitation of new solar cycles. When combined with a period of 11.8 yr, associated with the free-running length of a solar cycle, the mean cycle length of 11.06 yr and a phase variation of 190 yr are explained. Similarly the amplitude variations with periods 88 and 59 yr (previously described as the 80-yr cycle) are due to an amplitude modulation of the solar cycle by a period of 11.9 ± 0.3 yr. The results dispute several associations of planetary position and solar activity. (auth)

25492 KINEMATIC MODEL OF A SOLAR FLARE. Nakagawa, Y. (High Altitude Observatory, Boulder, CO); Wu, S. T.; Han, S. M. Solar Phys.; 30: No. 1, 111-120(May 1973).

Hyder advocated the idea that the optical (Hα) flares can be identified with the response of the solar chromosphere to an infalling material stream resulting from the "disparition brusque" of a prominence. Since some flares are observed without any apparent association with infalling streams, in this paper the possibility of identifying the optical flare with the response of the chromosphere to a supersonic disturbance is examined, i.e., a shock, propagating downward. The undisturbed chromosphere is represented by the Harvard–Smithsonian Reference Atmosphere and the evolution of the shock is evaluated with the use of the CCW (Chisnell, Chester, Whitham) approximation based on the theory of characteristics. It is shown that the chromosphere is heated by the shock and that radiation is enhanced, and that the enhanced radiation terminates the shock around the height of the temperature minimum. Numerical results obtained and possible future improvements of this type of study are discussed. (auth)

25493 ACCRETING GRAINS AS A MECHANISM FOR SEGREGATION. Williams, I. P. (Queen Mary Coll., London). pp 274-281 of Origin of the Solar System. Reeves, H. (ed.). Paris; Centre National de la Recherche Scientifique (1972).

From symposium on the origin of the solar system; Nice, France (3 Apr 1972).

The problems concerned with the segregation of the heavier elements from the hydrogen and helium in order to form the terrestrial planets from material with an original composition similar to stellar or interstellar material are reviewed. Possible solutions such as accretion are examined. Future investigation programs are envisaged. (FR)

25494 EXPERIMENTAL APPROACH TO CIRCUMSOLAR ACCRETION. Kerridge, J. F.; Vedder, J. F. (Ames Research Center, Moffett Field, CA). pp 282-283 of Origin of the Solar System. Reeves, H. (ed.). Paris; Centre National de la Recherche Scientifique (1972).

From symposium on the origin of the solar system; Nice, France (3 Apr 1972).

Micron-sized flakes of kaolinite were accelerated electrostatically up to velocities in the 1.5 to 9.5 km/sec range and used to bombard clino-chrysotile targets. These minerals were chosen because of their apparent similarity with the primitive constituents of carbonaceous meteorites. The range of impact velocities over which accretion occurs was investigated. The results are discussed. (FR)

25495 STELLAR WIND RADIATION DAMAGE IN COSMIC DUST GRAINS: IMPLICATIONS FOR THE HISTORY OF EARLY ACCRETION IN THE SOLAR NEBULA. Bibring, J. P.; Maurette, M. (CNRS, Orsay, France). pp 284-292 of Origin of the Solar System. Reeves, H. (ed.). Paris; Centre National de la Recherche Scientifique (1972).

From symposium on the origin of the solar system; Nice, France (3 Apr 1972).

An attempt was made to analyze the combined effects of turbulence and irradiation implied by the early accretion in the solar nebula. The finest lunar dust grains were observed with a high-voltage electron microscope. Micron-sized mineral fragments irradiated with low-energy, intense helium and argon ion beams were also examined using the same techniques as well as external flakes from the protective paints of Surveyor II. A mechanism is proposed to explain the particles sticking. (FR)

25496 HYDRODYNAMICS OF THE COLLAPSE: ROTATION AND CONTRACTION. Ostriker, J. P. (Princeton Univ., NJ). pp 154-164 of Origin of the Solar System. Reeves, H. (ed.). Paris; Centre National de la Recherche Scientifique (1972).

From symposium on the origin of the solar system; Nice, France (3 Apr 1972).

Three points arise from classical hydrodynamic calculations made on the mass and angular momentum distributions in the primitive solar nebula. If electromagnetic forces do not dominate, rotational mass loss does not occur. Most of the mass must have resided in a slowly rotating part of the nebula since the fission (l = 2, m = 2) instability was avoided. The present bizarre angular momentum distribution probably is not a consequence of angular momentum transfer but of initial conditions, the comets remaining as fossils left over from the tail of the original angular momentum distribution. (FR)

25497 SOME FLUID DYNAMICAL PROBLEMS IN COSMOGONY. Spiegel, E. A. pp 165-178 of Origin of the Solar System. Reeves, H. (ed.). Paris; Centre National de la Recherche Scientifique (1972).

From symposium on the origin of the solar system; Nice, France (3 Apr 1972).

The possible formation of a disk by a collapsing rotating gas cloud is discussed briefly. The considerations involved in discussing rapidly rotating polytropic equilibrium models are outlined. For axisymmetric configurations, the limit of rapid rotation is easy to treat and it is found that the shapes of these polytropes can be surprising. Some aspects of the stability of such models are mentioned. A qualitative discussion of free turbulence is given and it is stressed that such turbulence can be intermittent. It is speculated that this intermittency may have profound consequences on gravitational instability. The consequences of the presence of dust on gravitational instability are also envisaged. (FR)

25498 PHYSICO-CHEMICAL PROCESSES IN THE SOLAR NEBULA, AS INFERRED FROM METEORITES. Anders, E. (Univ. of Chicago). pp 179-201 of Origin of the Solar System. Reeves, H. (ed.). Paris; Centre National de la Recherche Scientifique (1972).

From symposium on the origin of the solar system; Nice, France (3 Apr 1972).

Many properties of meteorites suggest that they were formed in a cooling solar nebula. Chemical differences among chondrites, encompassing nearly all known elements, can be accounted for by as few as 4 processes: loss of an early condensate (>1300°K), loss of nickel-iron (1050 to 700°K), partial remelting of the condensate (600 to 450°K), and accretion (500 to 360°K). The same processes seem to have affected the inner planets. Reasonably concordant accretion temperatures are obtained by various cosmothermometers: abundance of volatile metals (Pb, Bi, Tl, In); $^{18}O/^{16}O$ and $^{13}C/^{12}C$ fractionations; Fe^{2+} content of silicates; presence of low-temperature minerals (Fe_3O_4, FeS hydrated silicates). These accretion temperatures are 3 times higher than present blackbody temperatures in the asteroid belt, suggesting that accretion took place only during a high-temperature stage of necessarily short duration. Pressures seem to have been about 10^{-5} atm in the region of the ordinary chondrites; 2×10^{-6} atm in the region of carbonaceous chondrites. Laboratory experiments show that Fischer–Tropsch type reactions of CO, H_2, and NH_3 in the nebula, catalyzed by Fe_3O_4 or silicate grains, can also account for the organic compounds in meteorites and carbon isotope fractionations. Similar reactions in other solar nebula may be the source of interstellar molecules, as suggested by Herbig. (FR)

25499 ORIGIN AND COMPOSITION OF THE TERRESTRIAL PLANETS AND SATELLITES OF THE OUTER PLANETS. Lewis, J. S. (Massachusetts Inst. of Tech., Cambridge). pp 202-205 of Origin of the Solar System. Reeves, H. (ed.). Paris; Centre National de la Recherche Scientifique (1972).

From symposium on the origin of the solar system; Nice, France (3 Apr 1972).

A substantial radial temperature gradient is needed in the solar nebula in order to explain the observed compositions (densities) of the terrestrial planets. The composition of the bulk condensate in equilibrium with a solar-composition gas is calculated as a general function of pressure and temperature. The temperature dependence of the density of the condensate very closely agrees with the observed densities and density trends of the terrestrial planets and satellites of the outer planets. The radial temperature gradient required is compatible with that used by Cameron in his adiabatic model for the nebula. Physical metal-silicate fractionation need never be invoked to explain the observed densities. The presence of pronounced metal/silicate fractionation in meteorites and the absence of this effect in the planets is attributed to the completely democratic nature of accretion by gravitation, which is the dominant accretion agent for large bodies. (FR)

25500 NOBLE GAS ISOTOPES AND DEUTERIUM IN THE SOLAR SYSTEM. Geiss, J. (Univ., Bern). pp 217-236 of Origin of the Solar System. Reeves, H. (ed.). Paris; Centre National de la Recherche Scientifique (1972).

From symposium on the origin of the solar system; Nice, France (3 Apr 1972).

Abundances of noble-gas isotopes are given for the solar wind and estimated for the outer convective zone of the Sun. The isotopic abundance of deuterium was found to be much lower in the solar nebula and in the original Sun than in seawater or meteorites, implying that the neutron irradiation of solar material was less than previously estimated. Deuterium was probably enriched in low-hydrogen content planetary material by quasi-equilibrium chemical reactions between H_2 and other hydrogen compounds at low temperature. Possible relations between observed isotopic anomalies of terrestrial and meteoritic neon and xenon are discussed. (FR)

25501 ABC's OF TRAPPED HELIUM, NEON, AND ARGON IN METEORITES AND LUNAR SAMPLES. Black, D. C. (Ames Research Center, Moffett Field, CA). pp 237-244 of Origin of the Solar System. Reeves, H. (ed.). Paris; Centre National de la Recherche Scientifique (1972).

From symposium on the origin of the solar system; Nice, France (3 Apr 1972).

The origins of observed variations in isotopic composition of trapped helium, neon, and argon found in meteorites are discussed from the standpoint of what constraints they place on models of the origin of the solar system. (FR)

25502 COLLAPSE CALCULATIONS AND THEIR IMPLICATIONS FOR THE FORMATION OF THE SOLAR SYSTEM. Larson, R. B. (Yale Univ., New Haven). pp 142-153 of Origin of the Solar System. Reeves, H. (ed.). Paris; Centre National de la Recherche Scientifique (1972).

From symposium on the origin of the solar system; Nice, France (3 Apr 1972).

The results of the two main types of collapse calculations which have been made up to the present are briefly reviewed insofar as the results are relevant for the formation of the Sun and the solar system: the collapse of a spherical nonrotating interstellar cloud to form a star; the collapse of an axisymmetric rotating cloud. The spherical collapse problem has by now been studied in moderate detail, and it yields results which agree in many respects with the observed properties of newly formed stars. The collapse of a rotating cloud has so far been studied only in rather preliminary fashion, but it already appears from these calculations that the collapse of a rotating cloud will not lead in any very simple way to the formation of a solar system but will instead lead to the formation of a binary or multiple system of stars. As a result it seems most promising to view the formation of the solar system as having resulted from the accretion of material into a disc around an already existing embryo star during the later stages of the star formation process. Some aspects of this proposed accretion process are discussed. (FR)

25503 ORIGIN OF THE SOLAR SYSTEM: REVIEW OF CONCEPTS AND THEORIES. McCrea, W. H. (Univ. of Sussex, Brighton, Eng.). pp 2-20 of Origin of the Solar System. Reeves, H. (ed.). Paris; Centre National de la Recherche Scientifique (1972).

From symposium on the origin of the solar system; Nice, France (3 Apr 1972).

A short outline is given of some of the main empirical features of the solar system. Cataclysmic theories of its origin are briefly mentioned. The general concept of a solar nebula is described. Accumulation theories of the formation of planets from the nebula are sketched with some critical comments. A proto-planet theory of the origin of planets and satellites is then considered. An attempt is made to place as much as possible of the work in a general setting and to call attention to a number of physical mechanisms that feature in one way or another in a number of theories. (FR)

25504 MAGNETOHYDRODYNAMICS, HYDRODYNAMICS, DYNAMICS OF THE SOLAR SYSTEM. System in the Different Models. Mestel, L. (Univ. of Manchester, Eng.). pp 21-27 of Origin of the Solar System. Reeves, H. (ed.). Paris; Centre National de la Recherche Scientifique (1972).

From symposium on the origin of the solar system; Nice, France (3 Apr 1972).

Attention is concentrated on theoretical explanations of the three following features: the regularity of the solar system (the planetary orbits are nearly coplanar, have small excentricities, and the same sense of orbital motion as the solar rotation, the angular momentum of the solar system being parallel to the solar spin), the concentration of most of the angular momentum in the planets, which however have only 0.1% of the mass, and the Titius–Bode law written in the form: $r_n = r_0\beta^n$; $\beta = 1.9$. (FR)

25505 PRESENTATION OF THE MODELS. Reeves, H. (CNRS, Paris). pp 28-55 of Origin of the Solar System. Reeves, H. (ed.). Paris; Centre National de la Recherche Scientifique (1972).

From symposium on the origin of the solar system; Nice, France (3 Apr 1972).

Five different models explaining the origin of the solar system are presented. Four of these models assume that the Sun and planets arose from the same cloud. In the remaining model (due to Alfven–Arrhenius) the Sun, which was already formed, captured a cloud of interstellar matter with its magnetic field. A systematic difference in the isotopic composition of the Sun and that of the planets would favor this last model. The introduction of nucleosynthesis in these models is discussed. (FR)

25506 MODELS OF THE PRIMITIVE SOLAR NEBULA. Cameron, A. G. W. (Yeshiva Univ., New York). pp 56-70 of Origin of the Solar System. Reeves, H. (ed.). Paris; Centre National de la Recherche Scientifique (1972).

From symposium on the origin of the solar system; Nice, France (3 Apr 1972).

Recent work on the construction of numerical models of the primitive solar nebula and of chemical accumulation processes that can be expected to occur within it are summarized. (FR)

25507 SOME REMARKS ON SOLAR NEBULA TYPE THEORIES OF THE ORIGIN OF SOLAR SYSTEM. Ter Haar, D. pp 71-79 of Origin of the Solar System. Reeves, H. (ed.). Paris; Centre National de la Recherche Scientifique (1972).

From symposium on the origin of the solar system; Nice, France (3 Apr 1972).

The following topics are briefly discussed: turbulence in a circumsolar disk and some of its consequences, the temperature distribution in a circumsolar disk and some of its consequences, and the importance of the Titius–Bode law. (FR)

25508 RECONSTRUCTION OF THE HISTORY OF THE SOLAR SYSTEM. Arrhenius, G. (Univ. of California, San Diego, La Jolla). pp 80-88 of Origin of the Solar System. Reeves, H. (ed.). Paris; Centre National de la Recherche Scientifique (1972).

From symposium on the origin of the solar system; Nice, France (3 Apr 1972).

A reconstruction of the different stages in the evolution of the solar system is attempted using current observations as a guide. This treatment of the problem does not lead to a single simple model, but to an array of models having different degrees of perfection. (FR)

25509 ACCUMULATION OF THE PLANETS. Safronov, V. S. (Inst. of Physics of Rare Earths, Moscow). pp 89-113 of Origin of the Solar System. Reeves, H. (ed.). Paris; Centre National de la Recherche Scientifique (1972).

From symposium on the origin of the solar system; Nice, France (3 Apr 1972).

It is generally accepted that the planets have been formed by the accumulation of solid particles and bodies. Two stages in the process of planetary formation are envisaged: accumulation of the protoplanetary gas–dust cloud rotating around the Sun and its transformation into a large number of solid bodies; accumulation of these bodies and the evolution of the largest of these bodies into the planets. (FR)

25510 SOLAR MAGNETIC FIELDS. Giovanelli, R. G. (CSIRO, Sydney). pp 9-21 of 12th International Conference on Cosmic Rays. Hobart, Australia; International Union of Pure and Applied Physics (1971).

From 12th international conference on cosmic rays; Hobart, Australia (16 Aug 1971).

Solar magnetic field research is reviewed under the headings: convective motions and associated magnetic fields; flux transport; weak field regions; magnetic properties of sunspots and the solar cycle; and theories of the solar field and the sunspot cycle. (AT)

25511 RADIOHELIOGRAPH OBSERVATIONS OF HIGH-ENERGY PHENOMENA IN THE SOLAR CORONA. Wild, J. P. (CSIRO, Sydney). pp 29-38 of 12th International Conference on Cosmic Rays. Hobart, Australia; International Union of Pure and Applied Physics (1971).

From 12th international conference on cosmic rays; Hobart, Australia (16 Aug 1971).

Observations related to the acceleration and storage of cosmic rays are being carried out with the radioheliograph. Components of metre-wave emission are designated Type III (fast drift) bursts, Type II (slow-drift) bursts, moving Type IV bursts, flare continua, storm continua, and storms. Two interconnection processes of solar activity centers have been distinguished: correlated bursts from remote centers, and triggering of a remote event by a major disturbance some minutes after the initial disturbance. Observations of pulsations connected with bursts are described. They are thought to be related to particle acceleration. (AT)

25512 SOLAR PARTICLE PROPAGATION. Wibberenz, G. (Univ., Kiel). pp 204-234 of 12th International Conference on Cosmic Rays. Hobart, Australia; International Union of Pure and Applied Physics (1971).

From 12th international conference on cosmic rays; Hobart, Australia (16 Aug 1971).

Material presented during the conference is analyzed within the categories: improved instrumentation and statistics from continuous coverage of solar particle events; simultaneous measurement by space probes widely separated in longitude; accurate measurements of anisotropies during various phases of an event; increased knowledge of interplanetary magnetic field structures and calculation of local diffusion coefficients; detailed numerical solutions of the particle transport equations including anisotropic diffusion, convection and energy losses in the expanding solar wind; and classification of the types of solar particle events (prompt, delayed, recurrent), which seem to be connected with different types of activity centers on the Sun, where the acceleration, storage and leakage into interplanetary space occurs. (AT)

25513 METHODS OF INVESTIGATION OF SOLAR GRANULATION FIELD IN THE PRESENCE OF ATMOSPHERIC DISTURBANCE. Kerimbekov, M. B. Izv. Akad. Nauk Azerb. SSR, Ser. Fiz.-Tekh. Mat. Nauk; No. 2, 82-88(1972). (In Russian).

Different methods of the two-dimensional analysis of the second granule field were examined. Under these methods an increase of the contrast of the granulation picture and also its isolation from the disturbances introduced by the Earth's atmosphere were achieved. The results of the photometry of the granulation field on films removed August 18, 1969, were described. The use of television techniques for emphasis of the contours of the low-contrast structure was examined. (tr-auth)

25514 POWER SPECTRUM OF SMALL-SCALE IRREGULARITIES IN THE SOLAR WIND. Houminer, Z. (Cambridge Univ., Eng.). Planet. Space Sci.; 21: No. 8, 1367-1379(Aug 1973).

Day to day observations of interplanetary scintillation on ten strongly scintillating radio sources over a period of twelve months show that the power spectrum of the small-scale irregularities flattens considerably at temporal frequencies $\nu < 0.5$ Hz. This flattening defines a scale which increases uniformly between 0.1 AU from the Sun. The implication of this result is discussed. (auth)

25515 SOLAR NEUTRINOS, MARTIAN RIVERS, AND PRAESEPE. Sagan, C.; Young, A. T. (Cornell Univ., Ithaca, NY). Nature (London); 243: No. 5408, 459-460(22 Jun 1973).

The detection rate of solar neutrinos has been found to be significantly below the value predicted by contemporary theories of solar structure and evolution. The usual explanation of the discrepancy is episodic and probably periodic core expansion in the Sun. In the models so far developed mixing of ^{3}He, produced by the p–p process, is the initiating event. All the models identify epochs of anomalously low neutrino flux with epochs of anomalously low surface luminosity. This leads to the temptation to connect the present "ice age" on Earth with low solar luminosity. Conditions on Mars are discussed, including its climatic instability and the presence of dendritic channels, and it is considered that such luminosity variations, if they occur, are unlikely to be restricted to the Sun; other evolved main-sequence stars should experience similar fluctuations, and the color–magnitude diagrams of open and globular clusters might, in principle, be used as tests. The open cluster Praesepe may prove useful in this connection, and its color–magnitude diagram implies that solar-type stars experience luminosity excursions of just the order apparently required to resolve the solar neutrino and Martian river problems. (UK)

25516 COSMIC DUST, PLANETS, AND RELATED PROBLEMS. Di Benedetto, F. (Consiglio Nazionale delle Ricerche, Rome). Planet. Space Sci.; 21: No. 9, 1605-1615(Sep 1973).

The study of micrometeorites which reach the Earth and of cosmic dust in general in interplanetary space and in a planet's atmosphere may contribute significantly to the resolution of important astrophysical and geophysical problems, such as the origin and evolution of the solar system and the Universe, and the problem of medium range weather forecasting (for about a month), in addition to the practical problem of NASA's "Man in Space" Program. In this paper, the questions related to the fall of matter of cosmic origin on Earth, a possible mechanism for the capture of micrometeoric particles by the Earth and other planets of the solar system, are dealt with. (auth)

25517 CRYSTAL SPECTROMETRY OF ACTIVE REGIONS ON THE SUN. Brabban, D. H.; Glencross, W. M. (University Coll., London). Proc. Roy. Soc. (London), Ser. A; 334: No. 1597, 231-239(28 Aug 1973).

A crystal spectrometer has been flown on a sounding rocket to study the soft x-ray line emission from the Sun. Collimators, with a field of view 9 arc min square, allowed individual active regions to be observed. A detailed description of the instrument is given. Solar conditions at the time of launch are then discussed, together with a brief history of the three active regions studied. It is shown that the collimators performed satisfactorily. The spectrum of an active region is used to identify the important solar line emission, and a comparison of the spectra obtained near 1.7 nm is made. The temperatures of the regions are discussed, and it is shown that a nonisothermal model is required. A good correlation is found between the soft x-ray emission and other solar observations. (auth)

25518 SOLAR NEUTRINOS AS A POSSIBLE MEANS OF DIRECT OBSERVATION OF THE SUN'S INTERIOR. Martinsen, P. (Aarhus Univ., Denmark). Astron. Tidsskr.; 6: No. 2, 41-45(1973). (In Danish).

The significance of the neutrinos produced in the Sun's interior is pointed out. The emission of neutrinos and antineutrinos in β-decay is explained and the weak interaction of neutrinos with ^{37}Cl shown to form a means for their detection. Davis' experimental measurement of solar neutrinos using 400,000 liters of CCl_4 in a mine shaft 1500 m below ground level is described. The processes by which neutrinos are produced in the Sun's interior are discussed and the discrepancy between the theoretically predicted neutrino flux at the Earth and that measured by Davis is stated. Possible adjustments to the solar model to give better agreement as well as an improved method of neutrino detection are mentioned. The situation is stated to be open and further developments awaited with great interest. (NO)

25519 VERTICAL DISTRIBUTION OF MAGNETIC FIELD IN BRIGHT REGION OF SUNSPOT PENUMBRA. I. Guseinov, M. D. Izv. Krym. Astrofiz. Observ.; 44: 70-76(1972). (In Russian).

The absolute magnetic field strength H is derived from the study of 55 Fraunhofer lines originating at different photospheric depths (τ = 0.004 to 0.184). Magnetic field distribution is considered in the bright formation similar to solar faculae located in the common penumbra of the sunspot group. The polarization spectrogram of this region was obtained to Sept. 2, 1961 with the aid of the echellette spectrograph of the solar tower telescope of the Crimean Observatory. All spectral lines used for magnetic splitting measurements, except 5 lines, possess normal Zeeman splitting. A change of magnetic field strength H with depth is considered. The field has maximum strength H = 1150 gs at the depth h = 240 km and then decreasing and reaching the minimum value H = 725 gs at h = 110 km (a vertical gradient $\Delta H/\Delta h = +3.3$ gs/km). Then the field grows up again ($\Delta H/\Delta h = -2.1$ gs/km). The field strength H is equal to 850 gs at the level h = 50 km and it is decreasing down to the value H = 600 gs ($\Delta H/\Delta h = +5.0$ gs/km) near the photosphere–chromosphere boundary. (auth)

25520 DETERMINATION OF PHYSICAL PARAMETERS OF THE SUNSPOT. Baranovskii, E. A. Izv. Krym. Astrofiz. Observ.; 44: 87-93(1972). (In Russian).

On four echele grating spectra of two sunspots ($\lambda\lambda$5600 to 6300 Å; linear dispersion 0.5 Å/mm) the equivalent widths of 44 lines of Sc I, V I, Ti I, Cr I, Ca I, Na I, Fe I, Si I, Ni I, Sc II, Fe II, the intensity of the wings of 6 lines of Ca I and Fe I and the intensity of the continuous spectrum were measured and compared with the corresponding figures for the undisturbed photosphere. The temperature T, the electron pressure p_e, and the gas pressure P_g for sunspot umbra were derived from the examination of the measured values. It was found impossible to obtain satisfactory agreement between the observed and the calculated values without assumption that the additional absorption in the continuum exists. The electron pressure obtained for the umbra was 20 times less and the gas pressure was 3 times less as compared with those for the undisturbed photosphere. The additional absorption was found to rapidly increase towards the outer layers. The umbra model, derived in this way, was 4 to 5 times more transparent, than the photosphere. (auth)

25521 QUANTITATIVE ANALYSIS OF THE HYDROGEN LINES IN MOUSTACHES. Koval, A. N. Izv. Krym. Astrofiz. Observ.; 44: 94-102(1972). (In Russian).

The profiles of the hydrogen emission lines $H_\alpha - H_9$ in moustaches are considered. The characteristic feature of moustaches is the absence of absorption in the cores of H_8 and H_9 lines. It is shown that the Doppler broadening of emission is in good agreement with observations in the wings of moustaches: for $H_8 - H_8$ lines at $\Delta\lambda \geq 1.5$ Å and for H_α line at $\Delta\lambda \geq 2$ Å. The corresponding velocities are about 200 km/sec. But in the core of the lines there is some additional emission which in the case of H_8 line can also be described by Doppler distribution with the velocities about 60 km/sec. Thus the observed H_8 line emission can be considered as the overlapping of two Doppler broadened emissions with different $\Delta\lambda_D$. It is assumed that this additional emission can originate in the region of the chromosphere surrounding the core of the moustaches. With the aid of the additional emission in H_8 line the additional $H_\alpha - H_\epsilon$ emission profiles are calculated and the total emission profiles free of absorption are obtained. Using these profiles the population of quantum levels is obtained. The number of hydrogen atoms N_2 along the line of sight above moustaches is calculated. The height of the upper boundary of the emission layer in moustaches is estimated as 1300 km (above the base of the chromosphere). (auth)

25522 CHARACTER OF THE PROPAGATION OF THE EXCITATION FROM FLARES. Stepanyan, N. N. Izv. Krym. Astrofiz. Observ.; 44: 103-106(1972). (In Russian).

It is noted that in many flares one deals with two phenomena: a) the flare itself, corresponding to the first maximum of the light curve, and b) the phenomena connected with the propagation of the excitation from the flare through the chromosphere (the decay part of the light curve). As a possible mechanism of the propagation of the excitation the strong shock wave is considered. Such a shock wave is supposed to appear in the region of the flare itself as a result of substantial energy release. The propagation of the shock waves of different strengths in the inhomogeneous chromosphere is considered. It is found that the typical forms of limb flares and the dependence of flare characteristics on the height of the flare appearance and some other properties can be explained in this way. (auth)

25523 OBSERVATIONS OF THE HELIUM LINES D_3 AND λ10830 Å IN ACTIVE REGIONS. Nguyen-Khanh. Izv. Krym. Astrofiz. Observ.; 44: 107-111(1972). (In Russian).

Helium lines D_3 and λ10830 Å are considered on the spectrograms obtained with the horizontal solar telescope of the Crimean Observatory. λ10830 observations were made with image-converter in the second order of the grating, the spectrograms of D_3-line were obtained with the echele spectrograph. The excitation temperature T_{ex} of the transition $2^3S - 2^3P$ was determined on the basis of the equivalent widths of the D_3-line and of the weak component of λ10829 Å. Doppler widths determined for λ10829 and λ10830-lines were in good agreement with the assumption of the constant source-function. Low excitation temperature T_{ex} agreed with the conclusion that the mechanism of line formation is the scattering of the photospheric radiation. The optical thickness in the center of the line λ10829 derived from the equivalent width of λ10829 and from the ratio of the intensity of two triplet components (λ10829 and λ10830) differ by the factor two. It can be explained by the chromospheric inhomogeneities observed in helium lines. It is shown that the turbulent velocity in helium regions is small ($\nu_t < 4$ km/sec). (auth)

25524 GEOMETRY OF THE LOCAL SOURCES ON THE SUN FROM OBSERVATIONS OF THE ECLIPSE ON SEPTEMBER 22, 1968. Eryushev, N. N.; Tsvetkov, L. I. Izv. Krym. Astrofiz. Observ.; 44: 112-121(1972). (In Russian).

The results regarding the position of the local sources from observations of the partial solar eclipse of September 22, 1968 are given. The observations were made with the aid of the 22-meter radio telescope of the Crimean Observatory at the wavelength 3.15 cm. Measurements of circularly polarized and of nonpolarized (the total intensity) radioemission were made. A close connection of the radio sources with the sunspot groups and the local magnetic fields at the photospheric level was found. The angular size of the local sources of the polarized emission was about the same as those of the umbra of sunspots. The fine structure (about 5″) of the sources of polarized emission was observed. The heights of the local sources as well as of the radio limb above the photosphere were determined. The upper boundary of the sources was found to be at the heights $(26 \pm 4) \cdot 10^3$ km for the polarized emission and $42 \cdot 10^3$ km for the total intensity. The position of the most intense part of the source in the total emission coincided with the region of polarized emission. (auth)

25525 DISTRIBUTION OF RADIO EMISSION OVER THE DISK OF THE SUN AT THE WAVELENGTHS 2, 4, 6, AND 8 mm. Efanov, V. A.; Kislyakov, A. G.; Lebskii, Yu. V.; Moiseev, I. G.; Naumov, A. I. Izv. Krym. Astrofiz. Observ.; 44: 137-173(1972). (In Russian).

Solar radio images (radio-isophotes) at the wavelengths 2, 4, 6, and 8 mm are presented. They were obtained as the result of the observations made with the aid of the 22 meter radiotelescope

of the Crimean Astrophysical Observatory. The resolutions were 1.2; 1; 1.3; and 1.6 at the wavelengths 2, 4, 6, and 8 mm, respectively. The wavelength dependence of the brightness temperature of the flux density and of the angular sizes of observed features on the disk were considered. It was found that the flux density of radio emission from the local sources rapidly decreases with the wavelength so that the spectrum of radioemission is not flat. (auth)

25526 VELOCITY FIELDS AT DIFFERENT LEVELS IN THE QUIET SOLAR REGIONS. Gopasyuk, S. I.; Tsap, T. T. (Izv. Krym. Astrofiz. Observ.; 44: 45-51(1972). (In Russian).

The velocity fields at the different levels of quiet regions on the Sun are considered. The records of the radial velocities were made in the lines H_α, K_3 Ca II, H_β, H_γ, H_δ, Mg I λ5184 Å, Ca I λ4227 Å, Na I D_1, Ba II λ4554 Å, Ca I λ6103 Å, Fe I λ5250 Å with the aid of double magnetograph. It is found that 1) mean velocity (averaged over the whole area) increases with the height outwards in the solar atmosphere. 2) There exists a good correlation between the velocities measured at adjacent layers, but the correlation decreases with the distance between the levels and it disappears for the velocities recorded in H_α and λ5250 Å lines. 3) The mean velocities in the active regions and in the quiet regions are approximately the same. (auth)

25527 LARGE-SCALE VELOCITY FIELDS IN THE SOLAR PHOTOSPHERE. Gopasyuk, S. I.; Kalman, B. Izv. Krym. Astrofiz. Observ.; 44: 52-63(1972). (In Russian).

The velocity fields over the whole solar disk are considered on the basis of the records of radial velocities made in the Fe I λ5250 Å and Ca I λ6103 Å lines with the double-magnetograph. The resolution of magnetograph was 9″ and 27″. It is shown that the velocities in the solar photosphere have isotropical distribution. The average diameter of the velocity cells is 27,000 km, and an average peak velocity is 320 m/sec. The diameter of a cell increases with the increasing peak velocity. For smaller characteristic dimensions the diameter increases with the same rate as peak velocity does. For large characteristic dimensions it increases as square root of peak velocity. (auth)

25528 MAGNETIC FIELDS AND OSCILLATORY MOTION IN THE SOLAR PHOTOSPHERE. Gopasyuk, S. I.; Tsap, T. T. (Crimean Astrophysics Observatory, Academy of Sciences of the USSR). Sov. Astron.-AJ 16: No. 5, 870-871 (Mar 1973).

Magnetograph measurements of radial velocities and longitudinal magnetic fields are used to study changes at the solar limb of the amplitudes of the oscillatory velocities and their connections with the magnetic fields. It is found that the five-minute oscillations have both vertical and horizontal components. The velocity amplitude of the five-minute oscillations decreases as the magnetic field strength increases. The velocity amplitudes of the slowly-changing components and the five-minute oscillations are nearly equal. (auth)

25529 ION ACCELERATION IN THE CURRENT LAYER OF A SOLAR FLARE. Tomozov, V. M. (P. K. Shternberg State Astronomical Institute). Sov. Astron.-AJ; 16: No. 5, 872-874(Mar 1973).

Acceleration of heavy multiply charged ions in the current layer of a solar flare by plasma oscillations is discussed. It is shown that ionosonic oscillations are capable of injecting ions into the mode of acceleration by Langmuir plasmons. In the case of nonrelativistic ions, the energy distribution function $f_\epsilon \approx \sqrt{\epsilon}$, while it falls exponentially in the high-energy range: $f_\epsilon \sim \epsilon^{\frac{1}{2}} e^{-(\epsilon/T^{eff})}$ it is pointed out that the magnetic field can drastically affect the threshold energy of particles leaving the current layer, since $E_{cr} \approx H^3$. (auth)

25530 ELECTRON-DENSITY DISTRIBUTION IN A CORONAL CONDENSATION. Vasil'ev, V. P. (Khar'kov University). Sov. Astron.-AJ 16: No. 5, 875-878 (Mar 1973).

Photographic photometry of the solar corona at the eclipse of September 22, 1968, has yielded an empirical law for the surface-brightness distribution in a coronal condensation, indicating that the knots in the condensation are spherically symmetric. Using a technique originally developed for the corona as a whole, an analytic expression is obtained for the electron density as a function of the distance from the nucleus of a condensation knot; this expression specifies a model for the condensation. In the densest part of a knot the electron density is at least 20 times that in coronal regions adjacent to the condensation. (auth)

25531 TEMPERATURE DISTRIBUTION IN THE SOLAR CORONA. É. Ya Vil'kovskii (Astrophysical Institute, Kazakh Academy of Sciences, Alma-Ata). Sov. Astron.-AJ 16: No. 5, 918-919 (Mar 1973).

Theoretical and observed temperature distributions are compared for open and closed structural elements. The good agreement indicates that the heat-balance analysis is reasonably accurate. (auth)

25532 EARLY INHOMOGENEITIES OF COMPOSITION AND THE SOLAR NEUTRINO PROBLEM. Prentice, A. J. R. (Monash Univ., Clayton, Australia). Mon. Notic. Roy. Astron. Soc.; 163: No. 3, 331-335(1973).

It is shown that if the Sun possesses a small burnt-out ($X_c = 0$) core covering some 2 to 3% of its mass, then the resulting neutrino flux will be at least a factor of 10 smaller than the corresponding values predicted by conventional solar models. It is suggested that such an exhausted core may develop after only $\sim 4.5.10^9$ yr if the radiative evolution of the Sun commences from an initially non-uniform chemical composition which is much richer in fractional helium abundance at the centre than the outside. Such an initial distribution may arise naturally, as a result of buoyant differentiation, if there had originally existed small-scale inhomogeneities in the composition of the interstellar material out of which the Sun was formed. (auth)

25533 SOLAR OPTICAL FLARES REPORTED UNDER NEW CLASSIFICATION. Mitra, R. K.; Sarkar, S. K.; Dasgupta, M. K. (Univ., Calcutta). Indian J. Radio Space Phys.; 1: No. 2, 170-174 (1972).

Solar optical flares, numbering 8230, reported during the period September 1967 to November 1969, which covers the peak phase of the current solar cycle, were examined in relation to percentage occurrences under different classes, position on the solar disk rise-time and duration and associated visual indications, numbering 26. From the study of the relative percentage occurrences of flares, it has been found that max. occurrences under different classifications are as follows: 58% normal (n), 82% subflares (S), and 47% dual importance (Sn). Percentage occurrences of flares under classes 2 and 3 increase with higher order of the intensity range and class 3 flares appear to be mostly bright. Regarding the distribution of flares on the solar disk, a strong north-south asymmetry exists for all classes of flares. East-west asymmetry is, however, negligible. Bright flares (b) are found to be inherently more impulsive in nature and the explosive phase (V) is mostly associated with these. Percentages of flares having some form of visual indications increase with increasing importance. Brilliant points (D and E), high-velocity dark surges (H), and eruptive centers (F) are found to be relatively more important in all classes of flares. (Indian Sci. Abstr.)

25534 ANNUAL VARIATION OF SOLAR FACULAE. Loewe, F. (Univ. of Melbourne). Gerlands Beitr. Geophys.; 82: No. 1, 25-26(1973).

In the calculations conducted the sunspot numbers have been replaced by their square roots in order to obtain a near normal distribution. The monthly means and their ranks in descending order are presented in a table. It is pointed out that the sunspot number is a rather artificial indicator of solar activity because it is derived from the number of spots and the number of groups of spots. Solar faculae can serve as another index for a possible annual variation. Mean monthly sizes of faculae in millionths of the visible solar surface for different periods, their ranks, and their roots for the time from 1942 to 1961 are presented in a table. (IAA)

25535 PERIODIC VARIATIONS IN GEOMAGNETIC ACTIVITY AND SECTOR STRUCTURE OF THE INTERPLANETARY MAGNETIC FIELD. Hauska, H. (Uppsala Univ.). Phys. Scr.; 7: No. 4, 183-188(1973).

Periodic variations, in the period range from 4 to 40 days, in geomagnetic activity are explained as due to the effects of the solar and interplanetary magnetic field structure. Solar active longitudes are identified as Bartels M-regions, by a series of recurrent low-energy proton events during 1961 to 1964. The dependence of the geomagnetic activity of the different components of the interplanetary magnetic field is studied. Linear relations for this dependence are given. An attempt is made to predict the interplanetary sector structure, during 1964, by using the polarity of solar magnetic fields. (auth)

25536 SEARCH FOR PERIODIC VARIATIONS IN GEOMAGNETIC ACTIVITY AND THEIR SOLAR CYCLE DEPENDENCE. Hauska, R. J.; Abdel-Wahab, S.; Dyring, E. (Uppsala Univ.). Phys. Scr.; 7: No. 3, 135-140(1973).

Periodic variations in geomagnetic activity have been investigated, in the range from 4 to 40 days, by means of power spectrum analysis during the period 1932 to 1969. Main periodicities are found to exist at periods of 28.7, 13.3, 9.1, and 6.9 days. To investigate the influence of recurrent magnetic storms on the periodic phenomena in the data, in particular the 27-day variation, an attempt has been made to remove disturbed periods from the data. The variation of the power density at different frequencies—particularly the 27-, 13-, 9-, and 6-day variation—with the solar cycle has been investigated. An average value of the period of the

27-day variation has been determined by means of a modified power spectrum technique. A high correlation with the solar cycle has been found and possibilities of a multiple cycle have also been discussed. (auth)

25537 PROBABILITIES FOR THE PEAK FLUX AND FLUENCE OF ENERGETIC SOLAR PROTONS INCIDENT ON INTERPLANETARY SPACECRAFT. Divine, N. JPL Quart. Tech. Rev.; 3: No. 2, 37-44(Jul 1973).

Energetic protons injected into interplanetary space in solar particle events can interfere with spacecraft operations and experiments and can cause permanent degradation of some components. For future long-term interplanetary and planetary missions, techniques have been developed which use solar particle event data from 1956 through 1970 to predict the probability of exceeding any value of peak proton intensity or mission proton fluence. Dependences on proton energy (near 10 to 100 MeV), heliocentric distance, and phase of the solar cycle are included. The techniques are described and applied to the Mariner Jupiter/Saturn 1977 mission. (auth)

25538 GEOPHYSICAL EFFECTS OF A PROTON BURST ON OCTOBER 28, 1963. Pushkova, G. N.; Iudovich, L. A. pp 32-36 of Ionosfernye Vozmushcheniya i ikh Vliyanie na Radiosvyaz. Zevakina, R. A. (ed.). Moscow; Izdatel'stvo Nauka (1971). (In Russian).

Data from a global network of stations are used for a detailed study of ionospheric disturbances coincident with a proton burst observed at 01.35 UT on that date. Variations in the electron concentration with altitude are given. Details are also given on the SC effect during the burst. (IAA)

25539 STATISTICAL CHARACTERISTICS OF ACTIVE REGIONS WITH THE YELLOW CORONAL LINE. Letfus, V.; Ruzickova-Topolova, B. (Astronomical Inst., Ondrejov, Czech.). Bull. Astron. Inst. Czech.; 24: No. 4, 195-201(1973).

The catalog of 28 observations of the Ca XV λ 5694 Å yellow coronal line, carried out at Lomnický Štít between 1966 and 1970 (Rybanský, 1972), was used to analyze 24 active regions. The following characteristics were investigated: the size and the development of the active regions, their flare activity, the photospheric magnetic structure, and the radio emission of condensations at 9.1 cm, 21 cm, and 169 MHz. In agreement with earlier investigations, most of the analyzed active regions are formed by large spot groups with a high chromospheric activity. The analysis also shows that most active regions have a complicated magnetic structure with occurrences of $\beta\gamma$, γ, and δ configurations, and that they form a closed magnetic system. The radio characteristics on 9.1 and 21 cm differ comparatively little from the normal distribution. An exception is formed by groups old in development. On the other hand, on 169 MHz the analyzed regions display a very low activity which apparently ties up with their magnetic configuration. (auth)

25540 SPECTRUM OF THE S- AND B-COMPONENT OF SOLAR RADIO EMISSION AT DM-WAVELENGTHS. Krueger, A. (Central Inst. for Solar-Terrestrial Physics, Berlin); Olmr, J. Bull. Astron. Inst. Czech.; 24: No. 4, 202-207(1973).

The S- and B-components of the solar radio emission have been separated by means of a correlation analysis. Some comparisons with cyclic variations of the soft solar x-ray emission are included. The remarkable spectral maximum of the B-component in the dm-region is interpreted as an effect of an increase of coronal density during the solar cycle, shifting the emission level of medium dm-waves by increasing optical depths from cooler chromospheric into hotter coronal zones. (auth)

25541 IONIZED MOLECULES IN BCA PHOTOSPHERIC MODEL. Pande, M. C.; Gaur, V. P. (Uttar Prades State Observatory, naini Tal, India). Bull. Astron. Inst. Czech.; 24: No. 4, 207-209(1973).

The dissociation equilibrium of ionized diatomic molecular species CO^+, NO^+, OH^+, O_2^+, N_2^+, and H_2^+ in the BCA photospheric model is considered. The abundances of these species are in the order H_2^+, CO^+, OH^+, NO^+, O_2^+, and N_2^+. The equivalent width of R_1 (K = 30) line of the (0−3) band belonging to the transition $A^2\Pi_1 - X^2\Sigma^+$ of CO^+ is either 0.042 or 0.084 mA which shows that no detectible lines of CO^+ occur in the photospheric spectrum. (auth)

25542 SAHA'S EQUATION UNDER DEVIATION FROM THERMODYNAMIC EQUILIBRIUM. Kurochka, L. N. (Astronomical Inst., Ondrejov, Czechp. Bull. Astron. Inst. Czech.: 24: No. 4, 210-212(1973).

A form of Saha's equation is presented for two cases: for an optically thin medium in which the source function is determined by the external radiation field of the star, and for an optically thick medium without the above restriction of the source function. With the help of the equations derived, the upper and lower limits of the emission measure in flares was determined as an example. The total number of electrons and hydrogen atoms was estimated, and it was concluded that in optical flares there was not a sufficient number of particles for the generation of corpuscular streams, observed in them. (auth)

Galaxies

Refer also to abstracts 25378, 25404, 25451, and 25452.

25543 OBSERVATIONS OF INTERSTELLAR MATTER AND PROTOSTARS. Lequeux, J. (Observatoire de Paris, Meudon, France). pp 118-134 of Origin of the Solar System. Reeves, H. (ed.). Paris; Centre National de la Recherche Scientifique (1972).

From symposium on the origin of the solar system; Nice, France (3 Apr 1972).

Data on interstellar matter are reviewed with particular emphasis on the most recent results and on the highest concentrations currently observed (densities of more than 10^5 particles per cm^3). There is a lack of understanding of the evolutive processes between this stage and the protostars themselves. Observations of supposed protostars are also very briefly reviewed. (FR)

25544 INGREDIENTS OF INTERSTELLAR GRAINS. Greenberg, J. M. (State Univ. of New York, Albany). pp 135-141 of Origin of the Solar System. Reeves, H. (ed.). Paris; Centre National de la Recherche Scientifique (1972).

From symposium on the origin of the solar system; Nice, France (3 Apr 1972).

Silicates and H_2O are the only positively identified ingredients of the solid particles in space. Theoretical and indirect evidence leads to the suggestion of some iron and carbon components. The grains appear to bind all of the heavier elements (excluding helium) within a factor of two of their cosmic abundance. Their total mass is about $1/100$ of the hydrogen; i.e., of the order of $1/1000$ of the total mass of the Milky Way. The radiation modified dirty ice constituent made up of combinations of O, C, N, H in the grains is shown to be capable of generating the complex organic molecules observed in space. Laboratory experiments are described. (FR)

25545 ABUNDANCES OF THE ELEMENTS. Aller, L. H. (Univ. of California, Los Angeles). pp 39-52 of 12th International Conference on Cosmic Rays. Hobart, Australia; International Union of Pure and Applied Physics (1971).

From 12th international conference on cosmic rays; Hobart, Australia (16 Aug 1971).

A review is made of determinations of the chemical composition of the Local Galaxy with particular reference to the solar system, and young stars from the interstellar medium. Figures for relative quantities of C, N, O, Mg, Si, and Fe in the Sun and ζ Herculis are discussed together with measurements of elemental abundance in the solar atmosphere, and factors affecting the profiles of spectral lines. The He/H and $^3He/^4He$ ratios are briefly discussed. A comparison is made of the relative abundances of H, He, C, N, O, Ne, Cl, S, and Ar in the Sun, B-stars, and Orion. (AT)

25546 OBSERVATIONS OF INTERSTELLAR GAS AND MAGNETIC FIELDS. Mills, B. Y. (Univ. of Sydney). pp 72-94 of Hobart, Australia; International Union of Pure and Applied Physics (1971).

From 12th international conference on cosmic rays; Hobart, Australia (16 Aug 1971).

Interstellar matter coupled to the magnetic field (HI, HII, electrons) and the field itself are discussed with a view to providing indications for the determination of the structure, distribution, and magnitude of the field throughout the Local Galaxy. Particular problems are the mean density of interstellar matter in and between the spiral arms and at large heights above the galactic plane; and the existence of a galactic halo. (AT)

25547 DYNAMICAL EFFECTS OF COSMIC RAYS IN THE GALAXY AND THE GENERATION OF THE GALACTIC MAGNETIC FIELD. Parker, E. N. (Univ. of Chicago). pp 95-110 of 12th International Conference on Cosmic Rays. Hobart, Australia; International Union of Pure and Applied Physics (1971).

From 12th international conference on cosmic rays; Hobart, Australia (16 Aug 1971).

A review is made of the dynamical behavior of the galactic cosmic rays, magnetic field, and interstellar gas with particular reference to the origin and life of the cosmic rays and magnetic field. The dynamic state and equilibrium of the gaseous disk are discussed as well as cosmic ray escape, and generation of the galactic magnetic field. (AT)

25548 BUBBLE MODEL OF EXTRAGALACTIC RADIO SOURCES. Gull, S. F.; Northover, K. J. E. (Columbia Univ., NY). Nature (London); 244: No. 5411, 80-83(13 Jul 1973).

The components of radio sources are identified with bubbles of relativistic plasma arising through the hot gas which produces the x-ray emission from clusters of galaxies. Continuous release of energy in the nucleus of a galaxy will lead to the formation of two such bubbles, moving in opposite directions along the axis of rotation. (auth)

25549 HNCO IN THE GALACTIC CENTRE. Buhl, D. (National Radio Astronomy Observatory, Charlottesville, VA); Snyder, L. E.; Schwartz, P. R. Nature (London); 243: No. 5409, 513-514 (29 Jun 1973).

It is stated that the $1_{01}-0_{00}$ transition of the HNCO molecule at 21.9817 GHz has been detected using a 1.4 cm parametric amplifier at the NRAO 36ft telescope. Observations are here described made with the same receiver and the 85ft Maryland Point telescope at the US Naval Research Laboratory, and a map of the region around the galactic center source Sgr B2 was made. The HNCO cloud appeared to have a minimum diameter of ~5 arc min and was centered ~2 arc min north of the H_2O source Sgr B2 (OH). At a distance of ~10 kpc the cloud had a diameter of ~15 pc, and the total mass of HNCO was ~0.02 $M_\odot$. The molecular H_2 density in the cloud was calculated as $\geq 1.8 \times 10^5/cm^3$, and the abundance of HNCO relative to H_2 was $\leq 6 \times 10^{-11}$. This agrees well with the $\sim 2 \times 10^{-11}$ which would be expected from the product of the cosmic abundances of the constituent atoms. (UK)

25550 DIMENSIONS, ABSOLUTE MAGNITUDES, AND COLOR CHARACTERISTICS OF SPIRAL ARM PATCHES IN GALAXIES NGC 628, NGC 4254, AND NGC 5194. Pronik, I. I.; Chuvaev, K. K. Izv. Krym. Astrofiz. Observ.; 44: 40-44(1972). (In Russian).

Dimensions, absolute magnitudes, and color characteristics for dozens of spiral arm patches belonging to Sc galaxies NGC 628, NGC 4254, and NGC 5194 are given. These data were calculated using multicolor photometric measurements of photographs of the galaxies under consideration. The photographs were obtained on the 2.6 m telescope of the Crimean Observatory with an image converter and 6-9 glass and interference color filters. Most of the patches of NGC 5194 and probably the smallest ones of NGC 628 and NGC 4254 have the same dimensions and absolute magnitudes as that of the largest and brightest open clusters or associations of the Galaxy. The brightest spiral arms patches of galaxies studied are the very large groups of stars. Most of the patches contain groups of early and late type stars. (auth)

25551 SEGREGATION OF GRAINS IN INTERSTELLAR CLOUDS. Horedt, G. Mon. Notic. Roy. Astron. Soc.; 163: No. 3, 285-290(1973).

Exact analytical solutions are obtained for the segregation process of spherical interstellar grains of constant mass under the combined influence of gravitational and drag forces in a uniformly rotating gas cloud. In all cases the gravitational field of the cloud is taken to be that of a uniform sphere. In the case of some selected models, the time required for a grain to reach the equatorial plane of a rotating cloud or the centre of a non-rotating cloud is of order of 10^8 yr, but generally much longer. In the last two sections the implications of the results to the formation of stars through condensation of molecular hydrogen in the gravitational field of a core of grain material are discussed. Cores having masses of about 10^{26} g and negligible angular momentum are expected to be formed in a period of several times 10^8 yr. Heating of the cores and of the gas by resisted grains is not significant. (auth)

25552 REMARKABLE CLUSTER SHAKHBAZIAN I. Arp, H. C. (Carnegie Institution of Washington, DC); Burbidge, G. R.; Jones, T. W. Publ. Astron. Soc. Pac.; 85: No. 506, 423-426(Aug 1973).

A plate of the compact cluster of galaxies Shakhbazian I is shown and described. Various possible models for the cluster are analyzed. It is concluded, as did Robinson and Wampler (1973), that it is most likely a highly condensed bound cluster of compact galaxies. The total mass of the cluster is 4 to 7×10^{11} $M_\odot$, and the mass-to-light ratio (photographic) is 0.3 to 0.5. The nature of the galaxies, the size of the cluster, and the very small velocity dispersion all make this cluster unique. (auth)

25553 1972 PALOMAR SUPERNOVA SEARCH. Kowal, C. T.; Zwicky, F.; Sargent, W. L. W.; Searle, L. (Carnegie Inst. of Washington, DC.). Publ. Astron. Soc. Pac.; 85: No. 506, 427-435 (Aug 1973).

Thirteen supernovae were discovered at Palomar Observatory during 1972. In addition 24 supernovae were found on old plates of the Palomar Sky Survey. (WDM)

Cosmology

Refer also to abstract 26460.

25554 KINETIC THEORY OF SMALL PERTURBATIONS OF A SPATIALLY HOMOGENEOUS GRAVITATING MEDIUM. Magalinskii, V. B. (Department of Theoretical Physics, Lumumba University of the Friendship of Peoples). Sov. Astron.-AJ 16: No. 5, 830-836 (Mar 1973).

The kinetic equation with a self-consistent field of Newtonian attraction (the Vlasov equation) is applied to study small perturbations of the exact solution corresponding to a spatially homogeneous expanding medium. An integral equation is derived for the density perturbations: its kernel is determined by the undisturbed motion of matter and by the form of the undisturbed distribution function. Some general estimates are obtained and particular solutions of the integral equation investigated. In the special case where the undisturbed density has the critical value, the equation reduces to the one derived and studied by Bisnovatyi-Kogan and Zel'dovich. (auth)

25555 GRAVITATIONAL-WAVE OBSERVATIONS AS A TOOL FOR TESTING RELATIVISTIC GRAVITY. Eardley, D. M.; Lee, D. L.; Lightman, A. P. (California Institute of Technology, Pasadena, California, 91109); Wagoner, R. V.; Will, C. M. Phys. Rev. Lett. 30: No. 18, 884-886 (30 Apr 1973).

Gravitational-wave observations can be powerful tools in the testing of relativistic theories of gravity, Future experiments should be designed to search for six different types of polarization, and for anomalies in the propagation speed of the waves: $|c_{gravwaves}-c_{emwaves}| \leq 10^{-7} c_{emwaves}$. This Letter outlines the nature and implications of such measurements. (auth)

25556 CORRELATION OF REPORTED GRAVITATIONAL RADIATION EVENTS WITH TERRESTRIAL PHENOMENA. Tyson, J. A.; Maclennan, C. G.; Lanzerotti, L. J. (Bell Laboratories, Murray Hill, New Jersey, 07974). Phys. Rev. Lett. 30: No. 20, 1006-1009 (14 May 1973).

We report here the results of a statistical cross-correlation study between 262 of Weber's gravitational radiation events and various geophysical, meteorological, and other phenomena. A correlation at the 2.7 standard-deviation level is found between the gravitational radiation events and the measure of the magnetospheric ring-current intensity, and at the 3.0 standard-deviation level with sidereal time. The results imply that some of the reported gravity events could be caused by processes other than gravitational radiation. (auth)

Planetary Phenomena

Refer also to abstract 26204.

25557 DARKENING OF SILICATE ROCK POWDERS BY SOLAR WIND SPUTTERING. Hapke, B. (Univ. of Pittsburgh). Moon; 7: No. 3/4, 342-355(1973).

Hydrogen ion irradiation of powdered igneous rocks, including Apollo rocks, has been observed in the laboratory to darken the powders and to make their optical properties similar to the Moon's. An extensive series of investigations shows that this darkening is not spurious. These results are consistent with those of other investigators, including Nash (1967). Darkening of lunar igneous rock powders by the formation of solar wind-sputtered glass films is a real process which occurs on the Moon. The time scale for darkening of undisturbed lunar soil is of the order of 50,000 to 100,000 yr. Comparison of the rates of the formation of glasses on the lunar surface by solar wind sputter-deposition, meteorite impact melting, and impact vaporization-deposition indicates that these processes are of comparable importance under the present flux of meteorites. Thus the formation of glass by sputter-deposition must be regarded as a major process on the lunar surface. (auth)

25558 ELECTRICAL CONDUCTIVITY, INTERNAL TEMPERATURES, AND THERMAL EVOLUTION OF THE MOON. Duba, A.; Ringwood, A. E. (Australian National Univ., Canberra). Moon; 7: No. 3/4, 356-376(1973).

The electrical conductivity of olivine and pyroxene is a strong function of the fugacity of oxygen in the atmosphere with which the mineral is in equilibrium. Lunar temperature profiles calculated from data on the electrical conductivity of these two minerals at oxygen fugacities similar to those which exist in the Moon indicate considerably higher temperatures for the lunar interior than obtained from conductivity data collected under normal atmospheric conditions. These high interior temperatures, the extensive differentiation associated with the formation of the lunar maria, and the radioactive element content of the Moon indicate that the Moon

accreted at temperatures between 600 and 1000°C. Gravitational heating during accretion would lead to melting of at least the outer 200 km of the Moon and would produce conditions favorable to separation of a metal-sulfide melt sufficient to form a core of 200 to 300 km radius. Such a core would reach the center of the Moon within a few million years after accretion. This core could produce the remanent magnetization observed in the surface rocks. Dynamo action would cease with the cessation of convective motion within the core as the temperature of the surrounding mantle increased due to radioactive heating. With the radioactivity assumed in the present model and the high accretion temperature, this event would require less than 2 b.y., but more than 1.6 b.y. (auth)

25559 PROPERTIES OF THE SOLAR NEBULA AND THE ORIGIN OF THE MOON. Cameron, A. G. W. (Yeshiva Univ., New York). Moon; 7: No. 3/4, 377-383(1973).

The basic geochemical model of the structure of the Moon proposed by Anderson, in which the Moon is formed by differentiation of the calcium, aluminium, titanium-rich inclusions in the Allende meteorite, is accepted, and the conditions for formation of this Moon within the solar nebula models of Cameron and Pine are discussed. The basic material condenses while iron remains in the gaseous phase, which places the formation of the Moon slightly inside the orbit of Mercury. Some condensed metallic iron is likely to enter the Moon in this position, and since the Moon is assembled at a very high temperature, it is likely to have been fully molten, so that the iron can remove the iridium from the silicate material and carry it down to form a small core. Interactions between the Moon and Mercury lead to the present rather eccentric Mercury orbit and to a much more eccentric orbit for the Moon, reaching past the orbit of the Earth, establishing conditions which are necessary for capture of the Moon by the Earth. In this orbit the Moon, no longer fully molten, will sweep up additional material containing iron oxide. This history accounts in principle for the two major ways in which the bulk composition of the Moon differs from that of the Allende inclusions. (auth)

25560 APOLLO 15 AND 16 RESULTS OF THE INTEGRATED GEOCHEMICAL EXPERIMENT. Adler, I. (Goddard Space Flight Center, Greenbelt, MD); Trombka, J. I.; Lowman, P.; Schmadebeck, R.; Blodget, H.; Eller, E.; Yin, L.; Lamothe, R.; Osswald, G.; Gerard, J.; Gorenstein, P.; Bjorkholm, P.; Gursky, H.; Harris, B.; Arnold, J.; Metzger, A.; Reedy, R. Moon; 7: No. 3/4, 487-504 (1973).

A number of experiments carried in orbit on the Apollo 15 and 16 spacecraft were used in the compositional mapping of the lunar surface. The observations involved measurements of secondary (fluorescent) x rays, gamma rays, and alpha particle emissions. A large scale compositional map of over 20% of the lunar surface was obtained for the first time. It was possible to demonstrate significant chemical differences between the mare and the highlands, to find specific areas of high radioactivity and to learn something about the composition of the Moon's hidden side. (auth)

25561 DETERMINATION OF ISOTOPE RATIOS IN THE OUTER SOLAR SYSTEM. Owen, T. (State Univ. of New York, Stony Brook). pp 245-248 of Origin of the Solar System. Reeves, H. (ed.). Paris; Centre National de la Recherche Scientifique (1972).

From symposium on the origin of the solar system; Nice, France (3 Apr 1972).

The $^{12}C/^{13}C$ abundance ratio was recently reevaluated for a comet and determined for the first time for the atmosphere of Jupiter. There is no indication of large differences between the value obtained and the telluric value. Current progress in the determination of D/H value for the atmospheres of Jupiter and Saturn is discussed. (FR)

25562 APPARENT LOSS OF ANGULAR MOMENTUM IN THE EARTH–MOON SYSTEM. Weinstein, D. H.; Keeney, J. (Superior Oil Co., Houston, TX). Nature (London); 244: No. 5411, 83-84 (13 Jul 1973).

A mathematical interpretation is given of the conservation of angular momentum of the Earth–Moon system. From this it appears that there has been a continual loss of momentum from the oldest times. (UK)

25563 MEASUREMENTS OF HYDROGEN–HELIUM RADIATION AT SHOCK-LAYER TEMPERATURES APPROPRIATE FOR JUPITER ENTRY. Cooper, D. M.; Borucki, W. J. (Ames Research Center, Moffett Field, CA). J. Quant. Spectrosc. Radiative Transfer; 13: No. 10, 1047-1051(Oct 1973).

Shock waves traveling at approximately 16 km/sec into a gas mixture of 7% H_2 and 93% He were used to simulate the shock-layer conditions for a representative shallow entry into the Jovian atmosphere. The absolute intensities of line and continuum radiation were measured and the radiative cooling of the shock-heated gas is shown. (auth)

25564 INTERACTIONS OF THE SOLAR WIND WITH PLANETARY MAGNETIC FIELDS. Basic Principles and Observations. Beard, D. B. (Univ. of Kansas, Lawrence). Planet. Space Sci.; 21: No. 9, 1475-1496(Sep 1973).

A planetary magnetic field obstructs the supersonic expansion of the solar coronal ions and electrons and creates a cigar shaped bubble in the solar wind. The pressure of the solar wind on the bubble compresses and seriously distorts the planetary magnetic field. A review is given here of the theoretical calculations and experimental observation of the shape of the bubble and the configuration of the compressed magnetic field inside the surface. Other effects, namely the shock structure on the surface, the radiation belts, and the current in the antisolar side of the bubble are described as well as a simplified account of electric fields and the connection of the planetary field lines with interplanetary field lines. (auth)

25565 MARS-3 STUDIES A PLASMA. Vaisberg, O. L. Zemlya Vselennaya; 28-31(1973). (In Russian).

Data transmitted by the Mars-3 Martian orbiter are discussed with particular attention to the behavior of the solar wind in the vicinity of the planet. Some details are given on the plasma measurements performed by the Mars 2 and 3 areocentric orbiters during the many months of their active lives. (IAA)

25566 $^{18}O/^{16}O$ RATIOS IN LUNA 16 FINES. Javoy, M.; Marette, J.; Pineau, F. Geochim. Cosmochim. Acta; 37: No. 9, 2017-2019(Sep 1973).

Partial fluorination experiments developed on a 26 mg sample of Luna 16 fines show a big ^{18}O enrichment in the first oxygen evolved similar to those observed by Epstein and Taylor on Apollo samples and probably related to the high solar-wind content of this sample. (auth)

25567 ANALYTICAL THEORY OF MOVEMENT OF THE 5 JUPITER SATELLITE. Arazov, G. T. Izv. Akad. Nauk Azerb. SSR, Ser. Fiz.-Tekh. Mat. Nauk; No. 2, 75-81(1972). (In Russian).

The results of the analytical study of the movement of the Jupiter-5 satellite are reported. The disturbing effect of the Galilean satellite and the noncentrality of the gravitational field of Jupiter was taken into account. The theoretical data obtained were compared with observational data. (tr-auth)

25568 $^{87}Rb-^{87}Sr$ AGE OF FRAGMENTS AND SOILS FROM THE LUNAR SEA OF FERTILITY. Birck, J. L.; Allegre, C. J. Geochim. Cosmochim. Acta; 37: No. 9, 2025-2031(Sep 1973).

The Luna 16 materials were dated by the Rb–Sr method. An internal isochron age of 3.4 ± 0.2 has been determined for a 6 mg fragment. The Luna 16 total soil is poorer in radiogenic Sr than any other analyzed soil from the Moon. Apollo 14 and 15 soils have also been studied; all of them fall nearly on a 4.65 b.y. isochron with the ADOR initial $^{87}Sr/^{86}Sr$ ratio. A comparison of the integrated Rb/Sr of the basalt source region and the Rb/Sr of the rocks suggests that these basaltic fragments have been generated with only minor Rb/Sr fractionation. The existence of an old Rb-rich subcrust which contaminated the basalts is also in agreement with the present results. (auth)

25569 HELIUM, NEON, AND ARGON IN LEVEL C OF LUNA 16 FINES. Schultz, L.; Phinney, D.; Signer, P. (Swiss Federal Inst. of Tech., Zurich). Geochim. Cosmochim. Acta; 37: No. 9, 2021-2023(Sep 1973).

Concentration and isotopic composition of He, Ne, and Ar were determined in a bulk fines sample from Level C (20 to 22 cm) of the Luna 16 core. On comparing with other analyses it was found (1) that Luna 16 has the highest noble gas concentrations observed in lunar bulk soils and (2) no significant variation of the $^{40}Ar/^{36}Ar$ with depth. (auth)

25570 THERMAL HISTORY AND EVOLUTION OF THE MOON. Toksoz, M. N.; Solomon, S. C. (Massachusetts Inst. of Tech., Cambridge). Moon; 7: No. 3/4, 251-278(1973).

Possible models for the thermal evolution of the Moon are constrained by a wide assortment of lunar data. In this work, theoretical lunar temperature models are computed taking into account different initial conditions to represent possible accretion models and various abundances of heat sources to correspond to different compositions. Differentiation and convection are simulated in the numerical computational scheme. Models of the thermal evolution of the Moon that fit the chronology of igneous activity on the lunar surface, the stress history of the lunar lithosphere implied by the presence of mascons, and the surface concentrations of radioactive elements, involve extensive differentiation early in lunar history. This differentiation may be the result of rapid accretion and large-scale melting or of primary chemical layering during accretion. Differences in present-day temperatures for these two possibilities are significant in the inner 1000 km of the Moon and are not re-

solvable with presently available data. If the Apollo 15 heat is a representative value, the average uranium concentration in the Moon is 65 ± 15 ppb. This is consistent with achondritic bulk composition (between howardites and eucrites) for the Moon. (auth)

25571 TOPOLOGY OF INDUCED LUNAR MAGNETIC FIELDS. Schwartz, K.; Schubert, G. Moon; 7: No. 3/4, 279-292(1973).

Using the asymmetric theory of lunar induction derived by Schubert et al. (1973a), the total and induced magnetic field line structure within the Moon and the diamagnetic cavity were obtained. Total field distributions are shown for orientations of the oscillating interplanetary field parallel, perpendicular, and at 45° to the cavity axis. Induced field lines are shown only for the orientations of the interplanetary field parallel and orthogonal to the cavity axis. When compared with the field lines derived using the long wavelength limit of spherically symmetric vacuum induction theory, the configurations obtained using the asymmetric theory exhibit significant distortion. For all orientations of the interplanetary field, the field lines are strongly compressed on the sunlit hemisphere because of the confining solar-wind pressure at the lunar surface and the exclusion of the field by the lunar "core." Field line compression is also observed in the antisolar region in agreement with the experimental observations of Schubert et al. (1973b) and Smith et al. (1973). For the parallel orientation of the interplanetary field, antisolar compression is caused by cavity confinement of the induced field. For the interplanetary field perpendicular to the cavity axis there is, in addition to compression by the cavity boundary, redistribution of field lines from the sunlit to the night side. In this case field lines entering the Moon just forward of the limb pass through the lunar "crust" on the night side and then exit forward of the limb. This phenomenon manifests itself as a displacement of the null in the induced magnetic field at the surface sunward of the limb, in striking similarity to the magnetospheric field lines of the Earth. (auth)

25572 CONJECTURES ABOUT THE EVOLUTION OF THE MOON. Gold, T. (Cornell Univ., Ithaca, NY). Moon; 7: No. 3/4, 293-306(1973).

The principal questions about the derivation of the lunar surface have not yet been settled: is it the surface left over from the process of accumulation of the Moon, or is it a surface generated by magmatic processes on the Moon and subsequently altered by further infall from outside? The evidence derived from many sources now favors the former. Seismic data suggest an absence of bedrock down to a depth of several kilometers, and instead a compacted powder only. The "mascon" evidence can be understood as a consequence of major impacts in a deep porous layer. The great abundance of cosmic-ray tracks in most soil samples demands a much greater cosmic-ray dosage than present rates would cause in the age of the Moon, unless the dust represented infallen material previously irradiated. The nuclear age, since freezing, of the dust is greater than that of the rocks found. The chemical composition of the dust is not the same as of the rocks. Strict layering of the dust has been seen, implying some process other than meteoritic impacts for its generation and deposition. These and other effects found can be understood in the framework of a cold accumulation description, in which the surface layers represent the last addition of meteoritic infall of a basaltic material similar to, but not identical with the present basaltic achondrites. The possible relation of this material to oceanic basalt on Earth is mentioned. (auth)

25573 ORBITAL MAPPING OF THE LUNAR MAGNETIC FIELD. Sharp, L. R. (Univ. of California, Los Angeles); Coleman, P. J. Jr.; Lichtenstein, B. R.; Russell, C. T.; Schubert, G. Moon; 7: No. 3/4, 322-341(1973).

Magnetometer data obtained during the first four lunations after the deployment of the Apollo 15 subsatellite have been used to construct contour maps of the lunar magnetic field referred to 100 km altitude. These contour maps cover a relatively small band on the lunar surface. Within the region covered there is a marked near side–far side asymmetry. The near-side field is generally weaker and less structured than the far-side field. The strongest intrinsic lunar magnetic field detected is between the craters Van de Graaff and Aitken, centered at 20°S and 172°E. The variation in field strength with altitude for this feature suggests that its scale size is on the order of 80 km. A magnetization contrast between this region and its surroundings of the order of 6×10^{-5} emu-cm^{-3} is obtained assuming a 10-km thick slab. Preliminary Apollo 16 magnetometer data at extremely low altitude (0 to 10 km) show a very structured magnetic field with field strengths up to 56 γ. Large compressions in the magnetic field magnitude, just above the lunar limb regions, are occasionally detected when the Moon is in the solar wind. The occurrence of limb compressions is strongly dependent on the selenographic coordinates of the lunar region on the solar-wind terminator beneath the orbit of the sub-satellite. The discovery of remanent magnetization of varying strength over much of the lunar surface and its correlation with limb compression source regions supports the hypothesis that limb compressions are due to the deflection of the solar wind by regions of strong magnetization at the lunar limbs. If this hypothesis is correct, then the map of lunar regions associated with compressions indicates that the northerly equatorial region on the far side is less strongly magnetized than the southerly equatorial region on the far side. (auth)

25574 APOLLO 16 NEUTRON STRATIGRAPHY. Russ, G. P. III (California Inst. of Tech., Pasadena). Earth Planet. Sci. Lett.; 19: No. 2, 275-289(Jun 1973).

The Apollo 16 soils have the largest low-energy neutron fluences (up to 10^{17} n/cm^2, E < 0.18 eV) yet observed in lunar samples. Variations in the isotopic ratios ^{158}Gd/^{157}Gd and ^{150}Sm/^{149}Sm (up to 1.9% and 2.0% respectively) indicate that the low-energy neutron fluence in the Apollo 16 drill stem increases with depth throughout the section sampled. Such a variation implies that accretion has been the dominant regolith "gardening" process at this location. The data may be fit by a model of continuous accretion of pre-irradiated material at a rate of ~70 g/(cm^2 · 10^8yr) or by models involving as few as two slabs of material in which the first slab could have been deposited as long as 10^9 yr ago. The ratio of the number of neutrons captured per atom by Sm to the number captured per atom by Gd is lower than in previously measured lunar samples, which implies a lower energy neutron spectrum at this site. The variation of this ratio with chemical composition is qualitatively similar to that predicted by Lingenfelter, Canfield, and Hampel. Variations are observed in the ratio ^{152}Gd/^{160}Gd which are fluence correlated and probably result from neutron capture by ^{151}Eu. (auth)

25575 RESPONSE TO A COMMENT ON U–Pb SYSTEMATICS IN LUNAR BASALTS. Tera, F.; Wasserburg, G. J. (California Inst. of Tech., Pasadena). Earth Planet. Sci. Lett.; 19: No. 2, 213-217(Jun 1973).

In a recent paper (1972) the authors presented U, Th, and Pb data for mineral samples and total rocks for two crystalline rocks from the Apollo 14 mission. Gale (1972) commented on the results of this study and in turn the authors herein rebut Gale's comments. (WDM)

PHYSICS (ATMOSPHERIC)

Auroral and Ionospheric Phenomena

Refer also to abstract 25538.

25576 (AD-740964) FIELD ALIGNED E- AND F-LAYER BACKSCATTER OBSERVATIONS. Basu, S.; Vesprini, R. L. (Emmanuel Coll., Boston, Mass. (USA)). Jan 1972. Contract F19628-71-C-0250. 56p. (AFCRL-72-128). NTIS.

In a reanalysis of the hf (19 MHz) backscatter data from Plum Island, MA, the occurrence of field aligned echoes from the E and F layers, called FAE (E) and FAE (F) respectively, was studied in detail. FAE (E) during quiet magnetic conditions (K (Fr)0-3) is a nighttime phenomenon with a definite maximum during the summer, when it is accompanied by groundscattered E (s). A weaker maximum is observed in the winter. (auth)

25577 (AD-756241) PHOTOELECTRON PROCESSES. Swartz, W. E. (Cornell Univ., Ithaca, N. Y. School of Electrical Engineering). 1972. Contract N00014-67-A-0077-0029. 15p. NTIS.

The problem of calculating electron and ion temperatures for theoretical ionospheric models is complicated by photoelectron transport (i.e., "nonlocal" effects) in the upper F2 region. Since former computer programs which restrict the flux distribution function do not provide consistent fluxes, a new generalized method was developed. (NTIS)

25578 (AD-756480) SOLAR PHOTOIONIZATION RATE CONSTANTS AND ULTRAVIOLET INTENSITIES. Keneshea, T. J.; Huffman, R. E. (Air Force Cambridge Research Labs., L. G. Hanscom Field, Mass.). 16 Nov 1972. 22p. (AFCRL-72-667; AFCRL-ERP-420). NTIS.

First-order rate constants for the photoionization of N_2, Q_2, O, and NO are presented for the altitude region from 60 to 200 km. The latest available data on the solar flux and absorption and photoionization cross sections in the wavelength region from 1216.7 to 1A are used. Tables are presented for latitude 30°N at equinox at solar zenith angles of 30, 60, and 75°. (auth) (NTIS)

25579 (AD-756684) RESEARCH ON HIGH-ALTITUDE PLASMA PHYSICS. Final Report, 1 July 1966–15 September 1972. Morse, D. L.; Destler, W. W.; Auer, P. L.; Nebenzahl, I. (Cornell Univ., Ithaca, N. Y. Lab. of Plasma Studies). Mar 1973. Contract N00014-A-0077-0002. 85p. NTIS.

The report contains a summary of problems investigated related to high-altitude plasma physics. References to detailed work in this area are given. The topics investigated fall into four general categories: (1) propagation of, and radiation from, relativistic electron beams, (2) plasma dynamics, shockwaves, and atomic collision processes, (3) plasma turbulence, and (4) theoretical studies. A detailed technical report on experiments simulating the release of artificial plasma clouds in the ionosphere is given. The results of these experiments are in substantial agreement with current theories of the motion and deformation of such clouds. (auth) (NTIS)

25580 (WRE-TN-A-226(AP)) OBSERVATIONS OF TRAVELLING IONOSPHERIC DISTURBANCES NEAR THE MAGNETIC DIP EQUATOR. Treharne, R. F. (Weapons Research Establishment, Salisbury (Australia)). Nov 1972. 15p. Dep. NTIS (U. S. Sales Only) $3.00.

Ionospheric tilt observations made with the aid of a three-dimensional direction finder near the magnetic equator are described. Certain medium scale components of the tilts observed during the evening have characteristics which have been identified with travelling ionospheric disturbances. TID properties such as direction and speed of travel, amplitude and wavelength are deduced from the observations which were made at a single observing site without using remote transmitters or receivers. (auth)

25581 THERMAL ELECTRON ENERGY DISTRIBUTION MEASUREMENTS IN THE IONOSPHERE. Hays, P. B.; Nagy, A. F. (Univ. of Michigan, Ann Arbor). Planet. Space Sci.; 21: No. 8, 1301-1306(Aug 1973).

Results of electron spectrometer and cylindrical Langmuir probe measurements of ionospheric electron energy distribution in the range from about 0.2 eV to 4.0 eV are presented and discussed. (auth)

25582 NUMERICAL STUDY OF POLAR IONOSPHERIC CURRENTS. Maeda, H. (Ames Research Center, Moffett Field, CA); Maekewa, K. Planet. Space Sci.; 21: No. 8, 1287-1300(Aug 1973).

Numerical calculations for the electric current in the polar ionosphere have been made by assuming some realistic distributions of the electric field and conductivity. Two dynamo actions are taken into account; one of which is induced by ionospheric winds and the other by the solar wind. For the solar-wind dynamo action, it is found that the secondary polarization field caused by nonuniform distribution of ionospheric conductivity is much larger than the primary field induced by the solar wind, suggesting its important effect on charged particles in the magnetosphere, and that the irrotational current having a source and sink is of the same order of magnitude as the solenoidal current closing its circuit in the ionosphere. It is also found that the solar wind is, in general, more effective than the ionospheric winds in producing polar current systems such as DP 1 and 2, but in some cases the ionospheric winds have a significant effect on the current distribution. (auth)

25583 EQUATORIAL IONOSPHERE. Beer, T. (Univ. of Ghana, Legion). Contemp. Phys.; 14: No. 4, 319-327(Jul 1973).

At the magnetic equator the Earth's magnetic field is completely horizontal. This provides a constraint on the motion of the charged particles that comprise the ionosphere and produces distinctive behavior in the equatorial ionosphere. Some of the unique aspects of the equatorial ionosphere in which active research is being undertaken are examined in sections entitled; the E region (the night-time valley, the equatorial electrojet, and sporadic E), the F region (the equatorial anomaly, motions of the F region, and spread F), and magnetic disturbances. (UK)

25584 COUNTER EQUATORIAL ELECTROJET CURRENTS IN THE INDIAN ZONE. Rastogi, R. G. (Physical Research Lab., Ahmedabad, India). Planet. Space Sci.; 21: No. 8, 1355-1365(Aug 1973).

The phenomenon of afternoon depression of the geomagnetic H field on quiet days near the magnetic equator in the Indian zone is described. These events occur most frequently around 1600 solar hr and are localized in longitude; sometimes, not seen at stations separated by even 2 hr LT. The geomagnetic disturbance tends to decrease or destroy the identity of the phenomenon. The latitudinal extent of these events is confined to the equatorial electrojet region. The events do not seem to be caused mainly by the Moon, but their occurrences are modified by the lunar age, being most frequent around new and full Moon. These events are associated with the disappearance of the q type of E_s over the equator for periods during which the H field is below the nighttime level. The currents responsible for these events flow westward in the E region and are within few degrees centered near the magnetic equator. (auth)

25585 WAVE-LIKE DISTURBANCES IN THE IONOSPHERE. Raitt, W. J. (University Coll., London); Clark, D. H. Nature (London); 243: No. 5409, 508-509(29 Jun 1973).

It has recently been suggested that atmospheric gravity waves could be expected to exist in the ionosphere as a result of the supersonic motion of the terminator (Beer, Nature 242: 34 (1973)). This suggestion is interesting in view of observations of the behavior of ionospheric electron temperature and density measured by the Langmuir probe experiment on ESRO-1A. Plots of electron temperature and density against UT were prepared for each orbit and revealed on occasions wave-like disturbances, described here. It is thought that the observed fluctuations may be magnetohydrodynamic waves stimulated by gravity waves in the lower ionosphere and causing plasma motion parallel to the magnetic field. The observations are presented as possible evidence for Beer's hypothesis. (UK)

25586 UT CONTROL OF THE TOPSIDE POLAR IONOSPHERE. Hopkins, H. D.; D'Arcy, R. J.; Sayers, J. (Univ. of Birmingham, Eng.). Planet. Space. Sci.; 21: No. 8, 1459-1462 (Aug 1973).

It has been appreciated for many years that the polar Antarctic ionosphere exhibits universal time (UT) control. However UT control of the topside Arctic ionosphere has not previously been reported. The present analysis uses the electron density data obtained during the periods 7 May to 30 August 1967 and 4 October 1967 to 31 January 1968 from the radiofrequency capacitance probe on board the Ariel 3 satellite, which was in a near-circular orbit at an altitude of 550 km and inclination 81°. The variation of the average electron density with UT during the polar winters in a geographic latitude and LT coordinate system and the corresponding variation for summer in both polar regions are shown and compared. It is noted that for the same months of the year the UT variation in the two hemispheres is in antiphase and also that the Arctic electron density changed little from winter to

summer as compared to the Antarctic electron density which increased by a factor of 5. The present results, within the limitations of averaging methods which involve the averaging of polar data over a wide range of latitude and over a whole season, establish that there is strong UT control of the Arctic topside ionosphere in winter and also, but to a lesser extent, in summer, contrary to previous observations and expectations. (UK)

25587 PROPAGATION OF ELECTROMAGNETIC WAVES IN A TWO-COMPONENT MAGNETOPLASMA. Nath, O.; Prasad, R. Y. (Banaras Hindu Univ., India). Indian J. Radio Space Phys.; 1: No. 2, 162-164(1972).

Expressions for attenuation and phase coefficients of electromagnetic waves propagating along the static magnetic field through a two-component plasma are developed. The effect of ions on the propagation characteristics is discussed. It is shown that the presence of ions can have a pronounced effect on the wave propagation near the ion gyrofrequency. The results are discussed in the light of ionospheric plasma. (Indian Sci. Abstr.)

25588 EFFECTS OF PROPAGATION PARALLEL TO THE MAGNETIC FIELD ON THE TYPE 1 ELECTROJET IRREGULARITY INSTABILITY. Lee, K.; Kennel, C. F. (Univ. of California, Los Angeles). Planet. Space Sci.; 21: No. 8, 1339-1343(Aug 1973).

A simple analysis indicates that Type I irregularities which have a slight component of propagation along the magnetic field may be more unstable than those which propagate across the field. Since these waves have very large group velocities, detailed ray tracing would be required to establish their true convective amplification. Nevertheless, there remains the possibility that significant irregularity amplitudes may occur at the northern or southern extremities of the equatorial electrojet from those modes with large north–south group velocity, and furthermore, they could significantly change the understanding of nonlinear solutions of the electrojet instability. (auth)

25589 OH BANDS AT MT. ABU, INDIA. Ramachandrarao, V.; Kulkarni, P. V. (Physics Research Lab., Ahmedabad, India). Indian J. Radio Space Phys.; 1: No. 2, 181-187(1972).

The intensities of two hydroxyl bands, OH (7-2) band origin at 6861 Å, and OH (8-3) band origin at 7273 Å, are recorded on all clear moonless nights at Mt. Abu, during the period Nov. 1966 to May 1969. Both the bands show striking simularities in their behavior showing very high positive correlation. The hydroxyl nightglow exhibits different types of nocturnal variation. Continuous decay till midnight followed by an increase in intensity toward dawn is the most common type of variation. The possible causes of the different types of variation exhibited by OH are discussed in view of the two excitation mechanisms proposed for the OH nightglow, considering the possible contribution from the two reactions. It is concluded that ozone-hydrogen mechanism is the main reaction as far as nocturnal variation is concerned. The OH nightglow shows max. intensity in winter months and min. intensity in Apr. This variation is more or less opposite to that of 5577 Å radiation. There is an apparent increase of OH intensity with solar activity, the intensity being more in the high active period. The OH intensity also increases following magnetic storms. (Indian Sci. Abstr.)

25590 ELECTRON TEMPERATURE MEASUREMENTS FROM COSMIC NOISE STUDIES. Sarma, S.B.S.S.; Sharma, M. C. (National Physics Lab., New Delhi). Indian J. Radio Space Phys.; 1: No. 2, 175-177(1972).

Several investigators have used the riometric absorption data for deriving the electron–ion collision frequencies and the electron temperature in the F region. In the present study the F region absorption contribution of cosmic radio noise at various latitudes has been utilized to derive the electron temperature. It is shown that the electron temperatures obtained from the present analysis are in good agreement with those from the in situ measurements. (Indian Sci. Abstr.)

25591 UNIFIED PICTURE OF THE PARALLEL WHISTLER MODE INSTABILITY. Landau, R. W.; Cuperman, S. (Tel Aviv Univ., Israel). J. Plasma Phys.; 9: No. 2, 143-159(Apr 1973).

A parametric investigation of parallel right-hand electromagnetic waves below the electron cyclotron frequency has been carried out; this wave is unstable for anisotropic temperature if $T_\perp > T_\parallel$. Simple analytic expressions for the maximum growth rate have been obtained. (auth)

25592 HEATING OF THE LOW-LATITUDE UPPER ATMOSPHERE CAUSED BY THE DECAYING MAGNETIC STORM RING CURRENT. Prolss, G. W.; Najita, K.; Yuen, P. C. (Univ. of Hawaii, Honolulu). J. Atmos. Terrest. Phys.; 35: No. 10, 1889-1901(Oct 1973).

An investigation is reported into the charge-exchange mechanism by which part of the energy contained in the magnetic storm ring current is injected into the low-latitude upper atmosphere and contributes to the energy balance in this region. The resulting temperature perturbation is estimated for a specific magnetic storm event and compared with that deduced from satellite drag data. It is found that the charge-exchange mechanism gives the correct temporal behavior of the magnetic storm associated changes in the upper-atmospheric temperature but cannot account for the magnitude of the observed temperature perturbation. An upper bound to the contribution of this mechanism to the low-latitude geomagnetic activity effect is estimated to be 30% during a large magnetic storm. (auth)

25593 COMPARISON OF THE LATITUDINAL VARIATION OF AURORAL ABSORPTION AT DIFFERENT LONGITUDES. Berkey, F. T. (Auroral Observatory, Tromsoe, Norway). J. Atmos. Terrest. Phys.; 35: No. 10, 1881-1887(Oct 1973).

An asymmetry in the longitudinal occurrence of auroral radiowave absorption has been noted several times in the literature. A comparison of the latitudinal profiles from four different longitudes indicates that energetic electron precipitation has a maximum in the Alaskan sector during moderately disturbed conditions. Furthermore, it is inferred that this asymmetry disappears during times of strong magnetic disturbance. (auth)

25594 SPREAD-F IN THE MIDLATITUDE IONOSPHERIC TROUGH ZONE. Nichol, D. G. (Davy-Ashmore Pty. Ltd., Melbourne). J. Atmos. Terrest. Phys.; 35: No. 10, 1869-1879(Oct 1973).

An examination is made of the relationship between spread F at higher midlatitudes and the formation of the F-region trough. It is concluded that the occurrence of spread F in the region is inversely proportional to the "depth" of the trough. It is suggested that this is caused by multiple reflections off the steep ionization contours at the "edges" of the trough producing F-region spreading. (auth)

25595 UPWARD PROPAGATION OF LF WAVES (ELECTRON WHISTLERS) INTO THE IONOSPHERE AND THE TURNING OF THE POYNTING VECTOR TOWARDS THE EARTH'S MAGNETIC FIELD. Al'pert, Ya. L.; Kaufman, R. N. J. Atmos. Terrest. Phys.; 35: No. 10, 1843-1851(Oct 1973).

The paper contains results of theoretical investigations of the propagation of lf (low frequency electron waves, $\omega_L < \omega < \omega_H$) into the ionosphere from below. The solution of the wave equation for two models of electron concentration with different height variations [N(z)] is given. It is shown that the energy flux turns quickly towards the direction of the Earth's magnetic field. For the chosen models the Poynting vector turns towards the magnetic field direction within a height range that lies between 1 and 20 km, i.e., within 0.1 and 7 wavelengths. The extent of this range decreases rapidly with increase of the electron concentration gradient dN/dz. (auth)

25596 ELECTRIC FIELD AND FINE STRUCTURE IN AURORA. Maaseide, K.; Holtet, J. A.; Egeland, A.; Maynard, N. C. (Norske Institutt for Kosmisk Fysikk, Oslo). J. Atmos. Terrest. Phys.; 35: No. 10, 1833-1841(Oct 1973).

Simultaneous rocket measurements of electric field and optical aurora during a weak PCA event are presented. The aurora consisted of faint structures superposed on a homogeneous glow, and on-board photometers showed that the rocket passed through two discrete auroral forms. These enhanced auroral emissions coincided with variations in the dc electric field and an increase in the ac field. A detailed comparison between electric fields and optical emissions shows that the relation is quite complex. The results are compared with earlier electric field and optical auroral measurements. (auth)

25597 GENERALIZED AERONOMIC MODEL OF THE MESOSPHERE AND LOWER THERMOSPHERE INCLUDING IONOSPHERIC PROCESSES. Hunt, B. G. (Commonwealth Meteorology Research Centre, Melbourne). J. Atmos. Terrest. Phys.; 35: No. 10, 1755-1798(Oct 1973).

An elaborate photochemical model of the Earth's tropical atmosphere from 60 to 160 km has been constructed. The model incorporates 46 constituents, and associated chemical reactions, for an oxygen–hydrogen–nitrogen–carbon atmosphere involving neutral, electronically excited and both positive and negative ionized species. The diurnal variation of the Sun is included, as are both molecular and eddy diffusion processes for the long-lived species. Midday and midnight vertical profiles for most of the constituents are presented. Detailed analyses are given for the diffusive-photochemical balances occurring in the nitrogen and carbon atmospheres, and these illustrate the conservative nature of the overall chemical processes. In general fair agreement was obtained with many of the observed features of the actual atmosphere. However the O and O_3 distribution indicate that some modification is desirable in the chosen eddy diffusion profile. The

individual and diurnal features of the E region of the ionosphere were quite well reproduced, external sources of ionizing radiation being included to maintain the nocturnal ionization. Although the chemistry of the D region is poorly known at present the model reproduced the gross ionization characteristics. The diurnal variation of O plays a vital part in determining the electron density in this region and, in particular, the day to night differences in the electron profiles. A detailed discussion is presented of the positive and negative ion distribution of the D region. The model emphasizes a number of aspects of the aeronomy for which further laboratory and atmospheric studies are highly desirable. (auth)

25598 PHASE INTEGRAL CORRECTIONS TO RADIO WAVE ABSORPTION AND VIRTUAL HEIGHT FOR MODEL IONOSPHERIC LAYERS. Kaur, P.; Srivastava, M. P.; Nath, N.; Setty, C. S. G. K. (Univ. of Delhi). J. Atmos. Terrest. Phys.; 35: No. 10, 1745-1754 (Oct 1973).

The phase integral solution of the wave equation is a fairly good approximation in computing the radio-wave absorption and virtual height for a slowly varying ionosphere. In the present paper different ionospheric electron density models have been used for E- and F-region heights and constant electron collision frequency for calculating the phase integral corrections to absorption and virtual height. It is found that the maximum corrections to absorption and virtual height for O-mode are of the order of 5 and 3% respectively, whereas for the X-mode they are comparatively smaller. It is also found that with increasing geomagnetic dip angle the corrections for the O-mode increase while those for the X-mode decrease. The results for the O-mode are in good agreement with the approximate expressions for absorption and virtual height given by earlier workers. However, no such explicit relations are available for the X-mode. (auth)

25599 MAINTENANCE OF THE F-REGION AT NIGHT. Incoherent Scatter Measurements at a Mid-Latitude Station. Jain, A. R.; Taylor, G. N.; Williams, P. J. S. (University Coll. of Wales, Aberystwyth). J. Atmos. Terrest. Phys.; 35: No. 10, 1717-1736(Oct 1973).

Observations of F-region plasma densities and temperatures made with the pulsed incoherent scatter radar at Malvern (52.1°N, 2.3°W) during six equinox and winter nights between October 1968 and October 1970 are presented. Two separate periods of apparent influx of plasma can be distinguished, one before and one after magnetic conjugate point (MCP) sunrise. The first influx period was seen on five nights and the second on two nights. In all except one case, hydrostatic equilibrium appears to have been preserved within the errors of measurement. By comparing the observed heat input to the electron gas with that expected if the apparent flux is due to in situ ionization by precipitating 200 eV electrons, it is found that for some periods part of the flux could be due to precipitation, but in other cases an influx of thermal plasma must be occurring. The equivalent vertical drift velocities required at great heights to produce the observed fluxes by diffusion from the exosphere seem anomalously large, especially for the post-MCP flux. It is suggested that when a plasma flux occurs, north–south horizontal transport caused by an east–west electric field is at least as probable a source as vertical transport by diffusion. (auth)

25600 ELECTRON DENSITY PROFILES ABOVE THE F-LAYER. Anastassiadis, M. (National Observatory, Athens); Moraitis, G.; Matsoukas, D. Planet. Space Sci.; 21: No. 9, 1581-1586(Sep 1973).

A method for the determination of electron densities up to 1000 km by using data from vertical sounding and Faraday rotation techniques is suggested. Electron density profiles and contours plotted following this method are compared with results obtained by Evans (Proc. Phys. Soc.; B69: 953(1956)) using the incoherent scatter technique. (auth)

25601 STUDY OF THE BEHAVIOR OF THE TOPSIDE IONOSPHERE DURING SUNRISE FROM ALOUETTE-I AND ALOUETTE-II SATELLITE DATA. Lakshmi, D. R.; Reddy, B. M. (National Physical Lab., New Delhi). Indian J. Radio Space Phys.; 1: No. 2, 154-157(1972).

The electron density profiles obtained by the Alouette-I and Alouette-II topside sounders were used to study the sunrise behavior of the topside ionosphere. Remarkable changes occur in the plasma scale height profiles at higher altitudes in the winter hemisphere even before the local sunrise, indicating significant heating due to conjugate photoelectrons. It is also possible to derive the upward velocity of plasma, due to thermal expansion after sunrise, from the plasma scale height profiles. The scale profiles do not indicate either significant changes in plasma temperature during sunrise period or the presence of a temperature gradient in the high latitude topside ionosphere. (Indian Sci. Abstr.)

25602 FORMATION AND MOVEMENT OF SPORADIC E. Pradhan, S. M.; Singh, B.; Srivastava, S. K.; Tantry, B. A. P. (Banaras Hindu Univ., India). Indian J. Radio Space Phys.; 1: No. 2, 141-144(1972).

Calculation of the electron density profile is done on the basis of the redistribution theory of sporadic E layer. The downward movement of the sequential sporadic E is discussed with the help of the corkscrew mechanism, and the decreasing velocity of the sporadic E peak with decreasing height is attributed to the viscous damping of gravity waves. The condition of formation of sporadic E, i.e. strong irregularities in the E region, is further investigated in a new way with the availability of recent data of simultaneous wind and electron density profiles. (Indian Sci. Abstr.)

25603 THERMAL STRUCTURE OF THE EQUATORIAL TOPSIDE IONOSPHERE. Narasingarao, B. C.; Singh, R. (National Physical Lab., New Delhi). Indian J. Radio Space Phys.; 1: No. 2, 151-153(1972).

The thermal structure of the equatorial topside ionosphere is theoretically investigated to explain the experimentally observed features, viz. (i) isothermal region in the 400 to 500 km range, (ii) close coupling of electron and ion temperature, and (iii) lower temperature compared to mid-latitudes. The main reasons for these features seem to be the larger electron densities in the 400 to 500 km range and the absence of protonospheric heat flux flowing into the topside ionosphere. The theoretical profiles, calculated on the above basis, are found to be in good agreement with the experimentally observed profiles in the 400 to 1000 km region. (Indian Sci. Abstr.)

25604 LUNAR EFFECTS IN IONOSPHERIC ABSORPTION AT KOKUBUNJI. Chakravarty, S. C.; Rastogi, R. G. (Physical Research Lab., Ahmedabad, India). Indian J. Radio Space Phys.; 1: No. 2, 158-161(1972).

Lunar oscillation in the ionospheric absorption for the frequency 2.4 MHz at Kokubunji was computed using the data for the period 1957-68. It was found that the lunar tide in absorption at Kokubunji behaves in a way opposite to that of the tide at an equatorial station like Colombo. The phase of the tide during E-months showed a reversal compared to the other two seasons of the year. The amplitude of the tide increased with the increase of solar activity. The maximum amplitude of the lunar tide in absorption takes place at stations within 20 ± 5° dip latitude. (Indian Sci. Abstr.)

25605 ROLE OF MOLECULAR NITROGEN COLUMN DENSITY IN CONTROLLING THE INTENSITY OF SPECTRAL EMISSION IN DAY GLOW DUE TO PHOTOELECTRONIC IMPACT. Singh, R.; Sharma, V. N.; Tolpadi, S. K. (Banaras Hindu Univ., India). Indian J. Radio Space Phys.; 1: No. 2, 178-180(1972).

Intensity-height profiles for a number of dayglow spectral emissions of molecular nitrogen arising from the impact of photoelectrons produced in the photoionization of the various atmospheric species due to solar ultraviolet radiations have been theoretically calculated using the column number density instead of mere number densities. The results show that the maximum intensity for a particular emission would be observed at a particular height in agreement with the rocket measured data. The intensity height profiles have been computed under different conditions of solar activity for some molecular nitrogen emissions expected to be observed in dayglow. The results of the present study are discussed in the light of earlier experimental results. (Indian Sci. Abstr.)

25606 DEVIATION OF CRITICAL FREQUENCIES IN THE F REGION FROM THEIR MEDIAN VALUES. Gaivoronskaia, T. V.; Sergeenko, N. P.; Iudovich, L. A. pp 55-73 of Ionosfernye Vozmushcheniya i ikh Vliyanie na Radiosvyaz. Zevakina, R. A. (ed.). Moscow; Izdatel'stvo Nauka (1971). (In Russian).

Analysis of the statistical distribution of the deviation of critical frequencies from their sliding median in the F region as a function of the solar cycle phase, latitude, and the time of the year and the day. Data from a network of stations widely spaced over the globe are used in the process. It is found that with increasing solar activity, the reliability of short wave radio communications diminishes at high and equatorial latitudes around the year, and gains in winter and at equinoxes at middle latitudes. Short wave radio communications were stabler during daytime than during nighttime at all latitudes in all seasons, irrespective of the solar activity level, with the exception of winter at high latitudes. Summer was most favorable for short wave radio communications at all latitudes for any solar activity levels. (IAA)

25607 CRITICAL-FREQUENCY FORECASTS IN THE F2 REGION. Kiseleva, M. V.; Kiyanovskii, M. P.; Kniaziuk, V. S.; Liakhova, L. N.; Iudovich, L. A. pp 74-99 of Ionosfernye Vozmushcheniya i ikh Vliyanie na Radiosvyaz. Zevakina, R. A. (ed.). Moscow; Izdatel'stvo Nauka (1971). (In Russian).

Solar activity maximum (1958) and minimum (1964) ionospheric data were used in an analysis of time–space correlations between

deviations of critical frequencies in the F2 region from their normal values. The time-invariability of critical radio frequencies was higher during negative disturbances and lower during positive disturbances at middle latitudes. The critical frequencies were stabler in summer than in winter, somewhat stabler by day than at night, and generally higher during the solar activity maximum year than during the minimum year. A space correlation analysis indicated a marked decrease of a complex time–space correlation coefficient with longitude and latitude. (IAA)

25608 PROGNOSIS OF THE GEOMETRICAL PARAMETERS OF N_h PROFILES AND h'h CHARACTERISTICS OF QUIET AND PERTURBED IONOSPHERES. II. Day-by-Day Fluctuations of the Parameters N_h and h'f. Potapova, N. I. pp 117-134 of Ionosfernye Vozmushcheniya i Ikh Vliyanie na Radiosvyaz. Zevakina, R. A. (ed.). Moscow; Izdatel'stvo Nauka (1971). (In Russian).

Analysis of the diurnal variations of the mean square deviation of the critical frequency of F2 from the monthly mean, on the basis of data collected at widely different latitudes during different solar activity phases. The day-by-day fluctuations of the effective signal reflection altitudes, due to F2 variations, are estimated for different latitudes. (IAA)

25609 PREDICTING OF N_h PROFILES AND h'f CHARACTERISTICS OF THE QUIET AND PERTURBED F REGION. III. Parameters N_h and h'f During Perturbations. Shapiro, B. S.; Shashun'kina, V. M. pp 135-145 of Ionosfernye Vozmushcheniya i ikh Vliyanie na Radiosvyaz. Zevakina, R. A. (ed.). Moscow; Izdatel'stvo Nauka (1971). (In Russian).

The principal mechanisms underlying the deviations of N(h) profiles and h'f characteristics from standard during ionospheric and magnetic storms are discussed as a function of the ionospheric and magnetic perturbation index and initial conditions in the ionosphere. The technique of compiling experimental literature data on predicting these deviations from average monthly values during the main perturbation phase and during the period of the ionospheric sudden commencement is briefly explained. (IAA)

25610 PREDICTION OF N_h PROFILES AND h'f CHARACTERISTICS OF THE QUIET AND PERTURBED IONOSPHERE. IV. Variations of Angles of Arrival and Skip Distances. Shapiro, B. S.; Potapova, N. I.; Anufrieva, T. A.; Freizon, I. A.; Shashun'kina, V. M. pp 146-163 of Ionosfernye Vozmushcheniya i ikh Vliyanie na Radiosvyaz. Zevakina, R. A. (ed.). Moscow; Izdatel'stvo Nauka (1971). (In Russian).

A discussion is given on problems relating to the prediction of variations of angles of arrival and skip distances on the basis of monthly forecasts of N(h) profiles and h'f characteristics. Maps for predicting the minimum effective height and the reflection height of a wave with a frequency close to the MUF are presented, as well as data concerning the day-to-day fluctuations of angles of arrival and skip distances at various latitudes and various solar activities. An analysis is made of the effect of various N(h) and h'f parameters on variations of angles of arrival and skip distances. The possibility of using periodically obtained information to decrease errors arising in the determination of angles of arrival and skip distances from predictions of mean monthly values of N(h) and h'f parameters for quiet days is discussed. Also considered are the errors in determining angles of arrival and skip distances during perturbations from predictions of quiet ionosphere parameters and a method of decreasing these errors with the aid of predictions of N(h) and h'f of the perturbed F region. (IAA)

25611 LONG-TERM FORECASTS OF NOONTIME N_h PROFILES. Timchenko, N. I. pp 164-168 of Ionosfernye Vozmushcheniya i ikh Vliyanie na Radiosvyaz. Zevakina, R. A. (ed.). Moscow; Izdatel'stvo Nauka (1971). (In Russian).

A calculation of N(h) profiles based on midday observations performed in Tomsk from 1958 to 1964 is shown to indicate the existence of a definite annual N variation at every level of the F region. Midday N values were investigated as a function of altitude for various intensity levels of solar activity. A method is proposed for forecasting the vertical distribution of midday electron concentration. (IAA)

25612 METHOD OF CALCULATING THE ABSORPTION AND INTENSITY OF THE RADIO-WAVE FIELD IN THE CASE OF OBLIQUE INCIDENCE IN THE IONOSPHERE, ON THE BASIS OF VERTICAL SOUNDING DATA. Pushkin, I. R.; Fligel, M. D. pp 169-181 of Ionosfernye Vozmushcheniya i Ikh Vliyanie na Radiosvyaz. Zevakina, R. A. (ed.). Moscow; Izdatel'stvo Nauka (1971). (In Russian).

A graphic method for calculating the intensity, lowest usable frequency, and lowest required power, with allowance for the antenna parameters, is proposed for distances at which the ionosphere may be considered to be free of variations. The method makes use of vertical sounding data on the propagation of radio waves in the ionosphere. A method of obtaining quantitative absorption estimates along the propagation path in the presence of disturbances is also proposed. It uses riometric measurements of the absorption of cosmic radio emission as the input data. (IAA)

25613 PROGNOSIS OF THE GEOMETRICAL PARAMETERS OF N_h PROFILES AND H'F CHARACTERISTICS OF QUIET AND PERTURBED IONOSPHERES. I. Regular Variations of the Geometrical Parameters N_h and h'f. Shapiro, B. S.; Anufrieva, T. A.; Freizon, A. A.; Vinnikova, T. L. pp 100-116 of Ionosfernye Vozmushcheniya i Ikh Vliyanie na Radiosvyaz. Zevakina, R. A. (ed.). Moscow; Izdatel'stvo Nauka (1971). (In Russian).

Discussion of deviations of N(h) and h'f from their normal values during an ionospheric magnetic storm vs the magnetic and ionospheric perturbation index, the time of the day, season, latitude, and solar activity level. Long-term prognosis procedures are given for the deviations during the main phase of a perturbation and during SC effects. (IAA)

25614 INFLUENCE OF IONOSPHERIC AND MAGNETIC DISTURBANCES ON SHORT-WAVE RADIO LINKS. Zevakina, R. A.; Kiseleva, M. V.; Pushkova, G. N.; Chernova, V. A. pp 182-192 of Ionosfernye Vozmushcheniya i Ikh Vliyanie na Radiosvyaz. Zevakina, R. A. (ed.). Moscow; Izdatel'stvo Nauka (1971). (In Russian).

Data from the Moscow transmitter received at Murmansk, Magadan, and Irkutsk are used to study the behavior of signal strength as a function of disturbances in the F2 region and the magnetic activity. Directional antennas and frequencies between 1.5 and 24 MHz were employed. It is found that both in undisturbed and disturbed conditions, highest signal strengths are obtained at frequencies 10 to 30% below the maximum usable frequency. Signal strength is affected most when ionospheric and magnetic disturbances are present simultaneously. (IAA)

25615 RELATIONSHIPS OF F-SCATTERING AT VARIOUS LATITUDES. Mednikova, N. V.; Zelenova, T. I. pp 193-206 of Ionosfernye Vozmushcheniya i Ikh Vliyanie na Radiosvyaz. Zevakina, R. A. (ed.). Moscow; Izdatel'stvo Nauka (1971). (In Russian).

The characteristics of F-scattering in time and space are studied at latitudes between 0 and 89°N and at several stations in the southern hemisphere. The maximum appearance probability and intensity of F-scattering are observed at the magnetic equator and the geomagnetic pole. Under quiet ionospheric conditions, F-scattering at equatorial latitudes occurs regularly between 19 and 06 hr. Starting with 20°, the nature of equatorial F-scattering and of its cyclic, seasonal, and diurnal variations changes abruptly, approaching that of high-latitude F-scattering. (IAA)

25616 VARIATION OF E_s WITH THE 11-YEAR SOLAR ACTIVITY CYCLE. Ovezgel'dyev, O. pp 207-217 of Ionosfernye Vozmushcheniya i Ikh Vliyanie na Radiosvyaz. Zevakina, R. A. (ed.). Moscow; Izdatel'stvo Nauka (1971). (In Russian).

The behavior of the sporadic E layer in the course of the solar activity cycle was examined on the basis of data from ten ionospheric stations located at different latitudes. It is shown that cyclic variations of the probability of occurrence of sporadic E and of its critical frequency are substantially dependent on the time of day and season. The probability of occurrence has a negative correlation and the critical frequency has a positive correlation with the solar activity level during daytime hours. Cyclic variations of sporadic E are less evident during nighttime hours. The observed cyclic variations are mainly caused by the indirect effects of cyclic variations of absorption in lower ionospheric regions. (IAA)

25617 FREQUENCY CHARACTERISTICS OF THE E_s LAYER. Ovezgel'dyev, O.; Babaev, A. pp 218-224 of Ionosfernye Vozmushcheniya i Ikh Vliyanie na Radiosvyaz. Zevakina, R. A. (ed.). Moscow; Izdatel'stvo Nauka (1971). (In Russian).

The fading rate for a single-pulse sporadic-E echo signal is examined as a function of the frequency characteristics of the sporadic-E layer. The nature of echo-signal fading is strongly dependent on both the critical frequency and the screening frequency, f(b), of the sporadic-E layer when the operating frequency exceeds the screening frequency. This dependence is absent when the operating frequency is below the screening frequency. (IAA)

25618 LOCAL CENTERS OF ANOMALOUS NOONTIME IONIZATION OF THE F2 LAYER AT MID-LATITUDES. Besprozvannaia, A. S.; Iudovich, L. A. pp 225-234 of Ionosfernye Vozmushcheniya i Ikh Vliyanie na Radiosvyaz. Zevakina, R. A. (ed.). Moscow; Izdatel'stvo Nauka (1971). (In Russian).

The distribution of the noontime ionization of the F2 layer throughout a worldwide network of stations is analyzed on the basis of a previously derived expression for the geographical distribution of noontime F2-layer ionization. Local centers of anom-

alous noontime ionization observed at mid-latitudes are most prominent in summer and winter soltice periods. The winter anomaly region forms a belt of reduced ionization levels covering the latitude intervals from 0 to 30° in the western sector and from 30 to 45° in the eastern sector of the northern hemisphere. Centers of anomalies are observed over the Caribbean and Japan in water and summer months. Possible causes of the anomalies are examined. (IAA)

25619 ANOMALOUS IONIZATION OF THE F REGION IN THE DARKENED HIGH-LATITUDE IONOSPHERE. Goncharova, E. E.; Iudovich, L. A. pp 37-54 of Ionosfernye Vozmushcheniya i Ikh Vliyanie na Radiosvyaz. Zevakina, R. A. (ed.). Moscow; Izdatel'stvo Nauka (1971). (In Russian).

Vertical sounding data from high-latitude stations in both hemispheres are used in a study of the variations in anomalous ionization of the F region during the growth and diminishing of solar activity. Shifts of anomalous ionization maxima toward earlier local time hours, and shifts of the equatorial boundary of anomalous ionization to the north are established during a decreasing solar activity. The oval form of incidence isocurves of anomalous ionization was observed throughout all years of the solar activity cycle. Significant changes in the geometry of the F layer and in the ionization levels above 180 to 200 km altitudes were found to occur during anomalous ionization. (IAA)

25620 IONOSFERNYE VOZMUSHCHENIYA I IKH VLIYANIE NA RADIOSVYAZ. (Ionospheric Perturbations and Their Effect on Radio Communication). Zevakina, R. A.; Liakhova, L. N. (eds.). Moscow; Izdatel'stvo Nauka (1971). 240p.

Ionospheric perturbations at high, middle, and equatorial latitudes, and advanced techniques for their forecasting are covered. The topics include statistical characteristics of ionospheric perturbations, vertical ionization profiles, F2 critical frequencies, N(h) profiles, short-wave propagation in a perturbed ionosphere, radio-wave absorption and reflection, and aspects of short-term ionospheric-perturbation predictions. Individual items are abstracted in this issue. (IAA)

25621 IONOSPHERIC DISTURBANCES. Zevakina, R. A. pp 3-26 of Ionosfernye Vozmushcheniya i Ikh Vliyanie na Radiosvyaz. Zevakina, R. A. (ed.). Moscow; Izdatel'stvo Nauka (1971). (In Russian).

Studies of ionospheric disturbances are reviewed, covering SID, polar cap absorption, auroral absorption, and F2 disturbances. Ionospheric disturbance prediction techniques are discussed. Refinement of these techniques is anticipated when more data on solar and geophysical activities are available in the future. (IAA)

25622 RELATION BETWEEN IONOSPHERIC DISTURBANCES AND THE PARAMETERS OF INTERPLANETARY MEDIUM. Kuleshova, V. P. pp 27-31 of Ionosfernye Vozmushcheniya i Ikh Vliyanie na Radiosvyaz. Zevakina, R. A. (ed.). Moscow; Izdatel'stvo Nauka (1971). (In Russian).

Ionospheric disturbances are analyzed vs the intensity and velocity of positive ion fluxes in interplanetary space as monitored by Mariner 2, Venus 3, and Vela 2. Higher proton velocities are noted during ionospheric and geomagnetic disturbances. Substantial fluctuations of F2 at high latitudes, following the intensification of positive ion fluxes in interplanetary space, are also indicated. (IAA)

25623 REPRESENTABILITY OF SID EFFECTS OBSERVED BY DIFFERENT METHODS. Letfus, V. (Astronomical Inst., Ondrejov., Czech.); Nestorov, G. (Bull. Astron. Inst. Czech.; 24: No. 4, 191-195(1973).

SID effects of solar flares, observed at different stations by various methods, are published summarily in the Solar Geophysical Data Prompt Reports. Since the beginning of 1971 also the data of the Ionospheric Station in Sofia, observed on a frequency of 164 kHz, using a transmitter at a distance of 1720 km, have been included among the SID's. These data have been placed among the SES method data. The published monthly reviews show that a comparatively large part of the SES data, especially with importance of 1- and 1, have only been recorded by the Sofia Station. This stimulated a more detailed statistical investigation of the contribution of the Sofia data in comparison to other stations. For this reason the relative occurrence frequencies of unique SID effects, recorded by a single station, were determined on the one hand, and on the other, the representation of the individual methods in detecting the SID's. It is shown that the SES data from Sofia since 1971 and from Úpice since 1972 have a considerable effect on increasing the relative frequencies of SES and SEA. The SPA, SWF, and SES methods are the most sensitive to detecting SID effects of flares. The SEA's are also capable of providing abundant information, provided they are recorded by suitable sensitive instruments with a diminished time constant. The observations on 164 kHz at the Sofia Station display a considerable sensitivity to weak flares, this sensitivity being in excess of the sensitivity of the 0 to 3 Å photometer on the Solrad 9 satellite. (auth)

Effects of Nuclear Detonations

25624 (LA-5257) DETERMINATION OF THE EMP ENHANCEMENT FACTOR. Benton, C. U.; Phillips, A. N.; Buchanan, R. W.; Fowles, H. M. (Los Alamos Scientific Lab., N. Mex.). Jul 1973. Contract W-7405-eng-36. 11p. Dep. NTIS $4.00.

EMP signals recorded aboard a C-135 aircraft are discussed with respect to the difference in amplitude and phase characteristics from that of a free-space signal. The enhancement factor is defined as the ratio of the normalized amplitude of the aircraft signal to the normalized amplitude of close-in sensors for a 2 MV pulsed antenna system. Three different close-in sensors were used to measure fields in excess of 10 kV/m. The radiation pattern was mapped in azimuth and elevation by the aircraft and the close-in sensors. The enhancement factor and the time rate of change of the EMP signal is seen to vary significantly with aircraft attitude and position. (auth)

Magnetospheric Phenomena

Refer also to abstracts 25359, 25460, 25462, 25535, and 25536.

25625 (AD-715938) THEORETICAL STUDIES OF SOLAR-GEOPHYSICAL RELATIONSHIPS USING RADIO TELESCOPE AND SATELLITE DATA. Papagiannis, M. D. (Boston Univ., Mass. (USA). Dept. of Astronomy). Nov 1970. Contract F19628-68-C-0097. 34p. (AFCRL-70-606). NTIS.

The research conducted under the contract includes the following projects: A study of the ionospheric total electron content during magnetic storms; A study of the world-wide distribution of the evening anomaly of the ionosphere; a study of the intensity and fluctuations of the 6300 A airglow line during periods of high and low scintillation activity; a study of the spectral characteristics of solar radio bursts in the microwave region (600 to 35,000 MHz); and a model for the source of Class I (nonimpulsive) solar x-ray bursts. (auth)

25626 (AD-760032) THEORETICAL ASPECTS OF ARTIFICIAL PLASMA INJECTION. Final Report. Cornwall, John M.; Schulz, M. (Aerospace Corp., El Segundo, Calif. Space Physics Lab.). 15 Jan 1973. 124p. (ATR-73(7279)-1). NTIS.

The report contains detailed theoretical studies of several aspects of a program to stimulate electromagnetic cyclotron instabilities in the magnetosphere through cold plasma injection. This includes discussions of the dynamics of an artificially injected lithium cloud, ion-EMC wave growth rates in a lithium plasma, the effects of plasma inhomogeneities and some remarks on the Post–Rosenbluth instability in a high-beta two-ion plasma. (auth) (NTIS)

25627 (AD-760058) INDUCED MAGNETOSPHERIC ELECTRIC FIELDS. Annual Report. Olson, W. P. (McDonnell Douglas Astronautics Co., Huntington Beach, Calif.). Mar 1973. Contract N00014-72-C-0233. 22p. NTIS.

The goal of the research is to understand and quantitatively model electric fields induced in the magnetosphere by changes in the magnetospheric magnetic field. It will then be possible to self consistently study particle and field behavior in a dynamic model of the magnetosphere. The most important sources of induced electric fields in the magnetosphere are changes in the tail magnetic field associated with substorms and magnetic storms and the daily wobble of the Earth's main field due to the inclination of the dipole axis to the Earth's rotation axis. (NTIS)

25628 (AD-760795) SHIELDING LENGTHS IN MAGNETOSPHERIC AND INTERPLANETARY PLASMAS. Research Report, August-October 1972. Cauffman, D. P. (Aerospace Corp., El Segundo, Calif.). 6 Apr 1973. Contract F04701-72-C-0073. 27p. (SAMSO-TR-73-168). NTIS.

A method is presented for estimating the characteristic shielding length of a spherical object that is immersed in a plasma when photoelectrons are being emitted by the object. In agreement with experimental evidence, the calculation reveals that shielding lengths for small probes are significantly closer to the Debye length than previously thought. These arguments are important for objects 1 m or less in diameter that are in the magnetosphere beyond the plasmasphere and in interplanetary space. This method of estimation is specifically applicable to thick sheaths; previous methods have assumed that sheaths would be thin compared with the size of the shielded object. (auth) (NTIS)

25629 (TRITA-EPP-72-11) MAGNETOSPHERE–IONOSPHERE COUPLING. Bostroem, R. (Kungliga Tekniska Hogs-

kolan, Stockholm (Sweden)). May 1972. 17p. (CONF-720556-2). Dep. NTIS (U.S. Sales Only) $3.00.

From COSPAR conference; Madrid, Spain (10 May 1972).

The electric coupling between the magnetosphere and ionosphere is discussed for time independent as well as time dependent fields. Substantial electric currents flow particularly during substorms along the geomagnetic field lines that connect the auroral regions to the magnetosphere. The properties of the current circuits are discussed in terms of idealized analog electric circuits with lumped impedances. The formation of auroral arcs may be an effect of the dynamic interaction of the ionosphere and magnetosphere. If the field-aligned current density exceeds a certain limit double layers may develop which give rise to nonnegligible voltage drops along the field lines and to auroral particle acceleration. The coupling to the ionosphere is of importance also for the convection of the magnetospheric plasma. Crucial experiments to increase our understanding of the coupling processes are simultaneous measurements of field-aligned currents and ionospheric or magnetospheric electric field distributions. (auth)

25630 MECHANISM FOR THE GROWTH PHASE OF MAGNETOSPHERIC SUBSTORMS. Hill, T. W. (Rice Univ., Houston, TX). Planet. Space Sci.; 21: No. 8, 1307-1316(Aug 1973).

A mechanism is presented whereby the rate of energy dissipation in the magnetosphere is controlled by the particle density in the plasma sheet in the near geomagnetic tail. The mechanism is based on a model in which the plasma sheet is sustained by injection of solar-wind particles into the dayside magnetosphere. The efficiency of the injection is controlled by solar-wind parameters, in particular, the north–south component of the interplanetary magnetic field; the maximum injection rate occurs when the interplanetary field is northward. During geomagnetically quiet times, this source balances the loss of particles from the edges of the tail current sheet. If the dayside source rate is reduced (e.g., by a southward-turning interplanetary magnetic field), then the plasma sheet is depleted and the rate of magnetic merging is enhanced in the earthward portion of the tail current sheet. This period of steadily-enhanced merging is associated with the growth phase, i.e., the period of enhanced magnetospheric convection for about one hour preceding the breakup of a polar magnetic or auroral substorm. The breakup can be understood as the result of the collapse of a portion of the tail current sheet following the local depletion of the plasma sheet. (auth)

25631 INFLUENCE OF A SUDDEN COMPRESSION OF THE MAGNETOSPHERE ON OUTER ZONE ELECTRON FLUXES MEASURED AT ARBITRARY PITCH-ANGLE. Kosik, J. C. (Univ., Toulouse). Planet. Space Sci.; 21: No. 8, 1345-1353(Aug 1973).

Analytical laws of motion of individual particles are used to evaluate the effects of a sudden compression on the outer radiation zone. A modulation of fluxes can be detected by synchronous satellites. Its intensity increases with the pitch-angle of the particles and the inward convection of field lines. (auth)

25632 ESRO AND THE MAGNETOSPHERE. Croome, A. (Central Office of Information, London). New Sci.; 58: No. 852, 816-818(28 Jun 1973).

A description is given of the European Space Research Organization magnetospheric studies. ESRO experiments, notably with the two HEOS spacecraft, have substantially advanced understanding of Earth–Sun relationships, and a recent international symposium sponsored by ESRO provided the opportunity to review progress on the magnetosphere and the coming experimental developments there. (auth)

25633 FREQUENCY-DIRECTION ANALYSIS OF GEOMAGNETIC PULSATIONS. 1. The Method. Dobes, K.; Prikner, K.; Strestik, J. (Geophysical Inst., Prague). Stud. Geophys. Geod.; 17: No. 3, 240-244(1973).

A new method is presented for computer processing of amplitude-time records. The method is based on a two-component spectral analysis, suitable for investigating a planar stationary oscillatory event. The method is applied to the study of the fine structure of short-period geomagnetic pulsations. Apart from a semi-quantitative representation of the directional distribution of the pulsation event in the plane of oscillation, the proposed method enables one to obtain quantitative information on the frequency components, representing the pulsation—the distribution of the overall energy in the spectrum of the pulsation, the ellipticity of the polarization ellipses, the orientation of the major axes of the ellipses, and the sense of rotation of the disturbance vector. (auth)

25634 NOSE FREQUENCIES OF WHISTLING ATMOSPHERICS OBSERVED IN SOFIA. Ralchovski, T. M. (Geophysical Inst., Sofia). Compt. Rend. Acad. Bulg. Sci.; 26: No. 3, 335-337(1973).

As reported earlier (Ralchovski, 1973), no nose whistlers were recorded at Sofia owing to the high values of frequencies with a minimal delay, which exceeded the upper boundary of the frequency range of the reception apparatus. An attempt is made to find the nose frequencies f_N and their delay t_N of ordinary whistlers recorded at Sofia, i.e., of whistlers which show no "nose" on spectrographic recordings. (WDM)

25635 INTERACTIONS OF PLASMAS WITH MAGNETIC FIELD BOUNDARIES. Phelps, A. D. R. (Imperial Coll. of Science and Tech., London). Planet. Space Sci.; 21: No. 9, 1497-1509(Sep 1973).

The magnetopause, the boundary layer, or current sheath, which separates the magnetosphere from the solar wind, is considered. The collision free electron skin depth, $\xi_e = c/\omega_{pe}$, where c is the velocity of light and ω_{pe} is the plasma frequency, gives a classical measure of the penetration depth of a collisionless plasma by an electromagnetic field. This penetration depth is small compared with the dimensions of the magnetosphere and hence the boundary layer may be conveniently considered in one dimension. In general, all one-dimensional solutions lie within an order of magnitude of the value of ξ_e, the only exception being the important one, in which the electric field perpendicular to the current sheath plane is not present, either due to a particular trapped particle distribution or due to a short circuiting end effect. For this exception, the thickness is increased by the factor $(m_i/m_e)^{\frac{1}{2}}$. The current sheath solutions discussed are equilibrium solutions but not necessarily stable equilibrium solutions. The extension of the models to three dimensions has a larger effect than at first might be expected. The effect may be intuitively understood as a consequence of flux conservation in the sheath. The one-dimensional solutions then correspond to the current sheath profiles at the thinnest point of the three-dimensional sheath. (auth)

25636 STABILITY OF A VORTEX SHEET BETWEEN COLLISIONLESS PLASMAS. Rajaram, R.; Kalra, G. L.; Tandon, J. N. (Univ. of Delhi). J. Plasma Phys.; 9: No. 2, 249-260 (Apr 1973).

The problem of stability of a vortex sheet between two collisionless plasma media is examined. The relevance of these investigations to the internal structure of the solar wind to the stability of the magnetosphere–solar wind boundary is discussed. (auth)

25637 WAVES IN A HOT PLASMA OF THE SOLAR WIND. Rehn, H. W. (Technische Univ., Brunswick). (1973). vp. (In German).

From 33rd annual meeting of the Deutsche Geophysikalische Gesellschaft eV and the Arbeitsgemeinschaft Extraterrestrische Physik; Goettingen, Ger. (5 Mar 1973).

For the case of a hot plasma with a magnetic field, the author calculates in the linear approximation, the transversal, right circular polarized waves in the proton frequency range, which propagate parallel to the magnetic field. The plasma consists of protons and electrons which obey the bi-Maxwell distribution having different temperatures parallel and perpendicular to the magnetic field. The imaginary part of the frequency, normalized by the gyrofrequency of the protons, and the phase rate, normalized by the speed of light, are plotted against the real frequency (abscissa) which is also normalized by the gyrofrequency of the protons. (GE)

25638 HEOS-2 OBSERVATION OF RELATIVISTIC ELECTRONS NEAR THE MAGNETOPAUSE IN HIGH LATITUDES. Wenzel, K. P.; Domingo, V.; Koehn, D.; Page, D. E.; Taylor, B. G.; Hedgecock, P. C. (European Space Research and Tech. Center, Noordwijk, Netherlands). (1973). vp. (In German).

From 33rd annual meeting of the Deutsche Geophysikalische Gesellschaft eV and the Arbeitsgemeinschaft Extraterrestrische Physik; Goettingen, Ger. (5 Mar 1973).

A report is given on the coordinated magnetic field and particle measurements in the magnetopause at high northern latitudes with the ESRO satellites HEOS-2 in a strongly eccentric orbit. In an average of 70 passages through the polar magnetosphere, a layer of energetic and relativistic electrons is found near the magnetopause. Over a broad energy region, this layer often contains electrons of more than 1 MeV. A factor of 3 to 100 for 40 keV electrons and 2 to 5 for 1 MeV electrons has been found for the transition to the environment. The relativistic electrons move preferentially in the direction toward the Sun. (GE)

25639 GROUND RISER WHISTLERS AT LOW LATITUDES. Singh, B.; Misra, S. N.; Tantry, B. A. P. (Banaras Hindu Univ., India). Indian J. Radio Space Phys.; 1: No. 2, 188-191(1972).

An attempt has been made to explain theoretically the characteristics of ground risers reported by Dikshit et al. (Nature, Lond., 1971, 230, 114). From computations employing Haselgrove two-dimensional ray tracing equation and the diffusive equilibrium model for electrons and ions in the magnetosphere, a riser whistler having all the characteristics of the reported

ground risers was computed. The riser waves, radiated from lightning discharge, with frequencies lying between 2.8 and 7 kHz and penetrating the ionosphere at different entry points, are found to reflect at different height during their quasitransverse propagation but form, after reflection, a bunch of waves to be received as a ground riser. The upper cutoff frequency (7 kHz) of the ground riser is explained in terms of the nonreflection of vlf waves in the same hemisphere as that of the originating atmospherics and crossing over the equatorial plane to be propagated in the opposite hemisphere; the lower cutoff frequency (2.8 kHz) of the whistler is explained in terms of deviation, after reflection, from the arrival latitude of the riser waves. (Indian Sci Abstr.)

25640 GROUND-BASED MEASUREMENTS OF IONOSPHERIC PHENOMENA ASSOCIATED WITH THE EQUATORIAL ELECTROJET. Rastogi, R. G.; Chandra, H.; Sharma, R. P.; Rajaram, G. (Physical Research Lab., Ahmedabad, India). Indian J. Radio Space Phys.; 1: No. 2, 119-135(1972).

The morphology of the equatorial electrojet current at different latitudes is described. The effects of geophysical disturbances like solar flares and geomagnetic storms as well as the regular changes like lunar tidal effects on the electrojet currents are reviewed. The effects of equatorial electrojet on the horizontal and vertical drifts in the ionosphere near the magnetic equator and on the occurrence of sporadic E reflections near the magnetic equator, are discussed. The origin of equatorial anomaly in the F2 region and the diurnal variation of f_0F_2 at low latitudes are shown to be directly related to the electrojet. The storm time and the lunar diurnal variation in the F2 region at low latitudes are found to be sympathetic to the corresponding variations in the electrojet. It is concluded that the F2 region between ±30′ dip as well as the E region between ±7′ dip is very closely connected with the equatorial electrojet currents. (Indian Sci. Abstr.)

PHYSICS (ATOMIC AND MOLECULAR)

Beams and Their Reactions

Refer also to abstracts 24133, 25214, and 25215.

25641 ELECTRON BEAMS AS CARRIERS OF OPTICAL COHERENCE. Favro, L. D.; Fradkin, D. M.; Kuo, P. K.; Rolnick, W. B. (Wayne State Univ., Detroit). pp 547-550 of Coherence and Quantum Optics. Mandel, L. (ed.). New York; Plenum Publishing Corp. (1973).

From 3rd Rochester conference on coherence and quantum optics; Rochester, NY (21 Jun 1972).

It is pointed out that a correct quantum mechanical understanding of the problem of using electrons as carriers of optical coherence involves the recognition that electron–electron phase correlations are induced by the first interaction with the radiation field. This amounts to a transfer of coherence information from the field to the electron beam. These correlations then cause the electrons to act collectively in subsequent emission processes. (JFP)

25642 POWER SUPPLY CIRCUIT FOR A PULSED PLASMA ELECTRON SOURCE. Gladskikh, A. I.; Shlyakhtun, V. E. Scientific-Research Inst. of Nuclear Physics, Tomsk, USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 1, 160-161(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 1, 136-137(1973).

A power supply circuit is described for a pulsed plasma electron source. Separate control of the discharge current and the accelerating voltage allows the optimal operating mode of the plasma source to be chosen. The source provides the possibility of obtaining an accelerated-electron energy of up to 60 keV and a beam current of up to 5 A in a pulse. (auth)

25643 CHARACTERISTICS OF A COLD CATHODE PLASMA ELECTRON GUN. O'Brien, B. B. Jr. (Northrop Corporation, Northrop Research and Technology Center, Laser Technology Laboratories, Hawthorne, California, 90250). Appl. Phys. Lett. 22: No. 10, 503-505 (15 May 1973).

A plasma discharge is described which can produce a large-area electron beam with energies up to 150 kV and current densities in excess of 1 A/cm^2 for durations of the order of 20 μs. For voltages up to ≈120 kV, durations of 100 μs or longer are attainable without arcing in the discharge. The discharge has a smooth cathode and will operate with various fill gases at pressure of about 10 μ. The device is being developed as an electron gun for high-pressure laser discharge stabilization. (auth)

25644 CHANNELING OF 3-keV H^+ IONS IN COPPER. Feijen, H. H. W.; Verhey, L. K.; Boers, A. L. (State Univ., Groningen, Netherlands). Phys. Lett.; 45A: No. 1, 31-32(27 Aug 1973).

Energy spectra and angle-dependent yield distributions of 3-keV H^+ ions scattered from a (001) face of a copper single crystal were measured. The spectra reveal channeling and semi-channeling effects at this relatively low primary energy. (auth)

Atomic and Molecular Properties

Refer also to abstracts 25176, 25685, and 25802.

25645 CLASSIFICATION OF THE OPTICAL SPECTRA OF LANTHANIDES. Blaise, J.; Wyart, J. F. (CNRS, Orsay, France). Rev. Chim. Miner.; 10: No. 1, 199-213(1973). (In French).

The main features of the spectra of neutral atoms and of singly or multiply ionized atoms of the lanthanides series are described. The experimental and theoretical methods used for analyzing these spectra are presented together with the way in which such spectra are classified. (FR)

25646 HYPERFINE STRUCTURE OF THE y^5P MULTIPLET OF $4f^7(^8S)6s6p$ IN Eu I. Champeau, R. J. (Groupe des Laboratoires, Bellevue, France); Handrich, E.; Walther, H. Z. Phys.; 260: No. 5, 361-365(1973).

The hyperfine splitting constants of the $4f^76s6py^6P_{\frac{5}{2}}$ level of Eu I were determined using the level crossing method. These values and those for the hyperfine splittings of the other $4f^76s6p$ levels are compared to theoretical values calculated with eigenfunctions of Smith and Collins. For the quadrupole coupling constants a better agreement between theory and experiment is obtained if different $\langle r^{-3}\rangle_p$ parameters are assumed for $4f^7(^8S)6s6p(^5P)$ and for $4f^7(^8S)6s6p(^1P)$. (2 tables) (auth)

25647 ACCURACY OF THE MANY-POINTS LOCAL PROCEDURES. Majorino, G. F.; Rubino, C. (Univ., Milan). Int. J. Quant. Chem.; 7: No. 4, 675-686(Jul 1973).

As until now proposed in the literature, in the local energy calculations one can distinguish "few-points" procedures, in which the number M of configurational points is strictly related to the number N of trial functions used, and statistical "many-points" procedures, in which the number M of points can be arbitrarily increased. It is demonstrated that the energy errors resulting from a "many-points" calculation M points/N functions (M > N) can be connected in a simple way with the errors of the (M/N) partial calculations N points/N functions. This suggests a possible approach for the problem of the choice of the configurational points to be introduced in the calculation, and leads to a simple interpretation of the numerical meaning of the error associated with the ordinary Ritz energy. Numerical examples on the hydrogen atom are reported. (auth)

25648 MULTIPOLE STRUCTURE OF EXCHANGE POLARIZATION ENERGY FOR H_2^+ ION. Chalasinski, G.; Jeziorski, B. (Univ., Warsaw). Int. J. Quant. Chem.; 7: No. 4, 745-757(Jul 1973).

The exchange polarization energy for the H_2^+ ion is expressed as an infinite sum of its angular components. At large internuclear distances R, a particular l-component, referred to as induced 2^l-pole exchange energy, behaves asymptotically like $-[4/(l+1)(l+2)(l+3)(l+4)\,Re^{-R}]$. For larger R this suggests a rather slow l^{-4} rate of convergence of the series. However, as contrasted to the analogous expansion for the induction energy the convergence speeds up considerably with decreasing internuclear separation. It is also shown that at sufficiently large R a given induced 2^l-pole exchange energy can be computed with a high accuracy using a polarization function obtained with neglect of charge overlap effects. Near the bottom of the van der Waals minimum over 99% of the exchange polarization energy can be produced using this simplified form of the polarization function. (auth)

25649 HYDROGEN-LIKE RELATIVISTIC CORRECTIONS FOR ELECTRIC AND MAGNETIC HYPERFINE INTEGRALS. Pyykko, P. (Univ. of Helsinki); Pajanne, E.; Inokuti, M. Int. J. Quant. Chem.; 7: No. 4, 785-806(Jul 1973).

Expressions are derived for the n-dependent, hydrogen-like relativistic corrections to the magnetic dipole and electric quadrupole radial hyperfine integrals of an arbitrary atomic state. Good agreement was obtained earlier between these corrections and the relativistic Hartree-Fock results for $s_{\frac{1}{2}}$ states. The agreement remains good for the $p_{\frac{1}{2}}$ states. For the $p_{\frac{3}{2}}$ states in heavier atoms the hydrogenic corrections still reproduce the Hartree-Fock trend. For the higher l values the agreement is poor. Numerical tables are given for $1 \le Z \le 100$ for the $s_{\frac{1}{2}}$, $p_{\frac{1}{2}}$, and $p_{\frac{3}{2}}$ magnetic dipole cases and the $p_{\frac{3}{2}}$ quadrupole case. (auth)

25650 MOLECULAR ORBITAL STUDIES ON SMALL MOLECULES USING H_2^+-TYPE ELLIPTICAL BASIS ORBITALS. Application to H_2^+, H_2, He_2^{3+}, and H_3^+. Llaguno, C. T.; Gupta, S. K.; Rothstein, S. M. (Brock Univ., St. Catharines, Ont.). Int. J. Quant. Chem.; 7: No. 4, 819-834(Jul 1973).

H_2^+-type elliptical orbitals are defined. These orbitals, which in elliptical coordinates involve a factor $(1+\xi)^\sigma$, are employed in variational calculations on the ground states of H_2^+ and H_2. Various choices of σ are explored for H_2^+, while two choices are used for H_2: the "boundary condition" and the "cusp condition" values. Variational energies are calculated and compared to the results of similar calculations. The H_2^+-type orbitals are employed in LCETO-MO-SCF calculations on the ground states of H_2 and He_2^{3+}. For both molecules a four-function basis set with two (nonlinear) variational parameters yields more than 99% of the Hartree-Fock limit. LCETO-MO-SCF calculations on triangular H_3^+ are discussed. Three four-function basis sets are used, and the best energy is −1.2306 a.u., which is in reasonable agreement with the Hartree-Fock limit, −1.2999 a.u. The best basis set is a four-term two-center expansion of the wave function with only one nonlinear variational parameter. A summary of the methods used to evaluate the integrals which arise in SCF calculations in the H_2^+-type elliptical orbital basis is given. (auth)

25651 PHOTOIONIZATION OF HELIUM METASTABLE ATOMS NEAR THRESHOLD. Stebbings, R. F.; Dunning, F. B.; Tittel, F. K.; Rundel, R. D. (Rice University, Houston, Texas, 77001). Phys. Rev. Lett. 30: No. 18, 815-817 (30 Apr 1973).

We have experimentally determined the absolute cross sections for the photoionization of $He(2^1S)$ and $He(2^3S)$ metastable atoms from threshold to 2400 Å. The results are compared with recent theoretical calculations. (auth)

25652 OBSERVATION OF THE FORBIDDEN $2^3S_1 - 1^1S_0$ SPONTANEOUS EMISSION LINE FROM HELIUM AND MEASUREMENT OF THE TRANSITION RATE. Moos, H. W.; Woodworth, J. R. (Department of Physics, The Johns Hopkins University, Baltimore, Maryland, 21218). Phys. Rev. Lett. 30: No. 17, 775-778 (23 Apr 1973).

The extremely forbidden transition $2^3S_1 - 1^1S_0$ at 625.56 Å has been observed in a He afterglow using time-resolved high-resolution spectrophotometric techniques. The spontaneous radiative transition rate was determined by measuring the photon emission rate from a known number of metastables at pressures of 0.05, 0.30, and 0.75 Torr. The value measured is 2.4×10^{-4} sec^{-1} with an experimental uncertainty of a factor of 3. (auth)

25653 FIELD CALIBRATION USING THE ENERGY DISTRIBUTION OF FIELD IONIZATION. Sakurai, T.; Müller, E. W. (Department of Physics, The Pennsylvania State University, University Park, Pennsylvania 16802). Phys. Rev. Lett. 30: No. 12, 532-535 (19 Mar 1973).

The accuracy of data obtained by field-ion microscopy is often limited by a $\pm$15% uncertainty of converting measured voltages into field strengths. Plotting the difference of relative energy deficits of free-space ionized H_2, D_2, or Kr for sets of two applied voltages against the logarithm of the voltage ratios yields a field factor k. The surface field $f_0 = V/kr_t$ is obtained with the 3% accuracy by which the tip radius r_t can be known. The method is applicable to all metals accessible to field-ion microscopy. (auth)

25654 STARK BROADENING OF HIGH-PRINCIPAL-QUANTUM-NUMBER $n-\alpha$ LINES OF HYDROGEN. LaSalle, T. R.; Nee, T.; Griem, H. R. (University of Maryland, College Park, Maryland, 20742). Phys. Rev. Lett. 30: No. 20, 944-948 (14 May 1973).

The first members of the hydrogen line series with lower states n=10, 11, 12, and 13 have been detected in a laboratory plasma. The width of the 12-α line at 88.7 μm could be measured and was consistent with calculated broadening from elastic electron collisions and quasistatic ion effects. (auth)

25655 FIRST IONIZATION POTENTIAL OF URANIUM AND THORIUM MEASURED IN A DC ARC PLASMA. Avni, R.; Klein, F. S. (Israel Atomic Energy Commission, Beersheva). Spectrochim. Acta, Part B; 28: No. 9, 331-338(Sep 1973).

The Saha relationship was used to derive the ionization potentials of uranium and thorium from measurements of temperature or of electron density in a plasma in thermodynamic equilibrium. Introducing into the plasma elements with well defined ionization potentials, such a Ba, Al, V, Cr, Zr, Mo, Cu, Si, and some of the rare-earths, as matrices, the temperature and electron density were measured in the central region of the arc plasma. A relation was established between the different ionization potentials and the plasma temperature or the electron density. From this relation the values of 6.3 ± 0.3 and 7.5 ± 0.3 eV were found for the ionization potentials of U and Th respectively. (auth)

25656 MULTIPHOTON IONIZATION INDUCED BY CIRCULARLY POLARIZED RADIATION. Gontier, Y.; Trahin, M. (Service de Physique Atomique, Centre d'Etudes Nucléaires de Saclay, BP n° 2-91, Gif-sur-Yvette, France). Phys. Rev. A 7: No. 6, 2069-2073 (June 1973).

The ratio μ_N of the cross section for circularly polarized light to that for linearly polarized is numerically investigated for N-photon ionization of atomic hydrogen. For $N<4$, it appears that the gain factor is greater than unity. For $N\geq4$, the ratio μ_N is generally smaller than unity and decreases when the multiphoton order N increases. (auth)

25657 HIGHER-ORDER EFFECTS IN RESONANT MULTIPHOTON PROCESSES. Gontier, Y.; Trahin, M. (Service de Physique Atomique, Centre d'Etudes Nucléaires de Saclay, B.P. No. 2 - 91 - Gif-sur-Yvette, France). Phys. Rev. A 7: No. 6, 1899-1911 (June 1973).

The multiphoton transitions in the hydrogen atom are investigated by taking into account the higher-order terms arising from the S-operator expansion. These higher-order effects originate induced shifts and induced breadths on the virtual-atomic-energy levels. It is shown that these perturbations play an important role for resonant multiphoton processes. In this case, the theory predicts a particular flux dependence of the transition rates. Furthermore, the well-known dispersion curves are strongly modified in the neighborhood of any resonance. Thus the transition rates can exhibit several peaks. Numerical results are given for a three-photon bound-free transition from the 2S state of hydrogen. (auth)

25658 QUANTUM SCATTERING THEORY OF ROTATIONAL RELAXATION AND SPECTRAL LINE SHAPES IN H_2-He GAS MIXTURES. Shafer, R.; Gordon, R. G. (Department of Chemistry, Harvard University, Cambridge, Massachusetts 02138). J. Chem. Phys. 58: No. 12, 5422-5443 (15 June 1973).

A systematic study is presented of the rotational relaxation and spectral line shape properties of dilute gas mixtures of H_2 in He, in an effort to determine the radial and angular dependence of the H_2-He intermolecular potential. The quantum mechanical theory of relaxation in gases is reviewed, and we express the results in terms of a matrix of cross sections that determines each correlation function, and thus the relaxation properties of the system. The cross section is calculated from binary collision transition amplitudes, or S matrix elements, for H_2-He scattering. A Morse-spline-fitted-Van der Waals potential of the form $V_0(R)+V_2(R)P_2(\cos\theta)$ is assumed and we treat the hydrogen molecule as a rigid rotor. The Schrödinger equation is solved in the close-coupling approximation using the method of Gordon. We apply the theory to sound absorption measurements of rotational relaxation, NMR spin-lattice relaxation times, and the S and Q branches of the pure rotational Raman spectrum of H_2-He mixtures. Elastic phase shift and reorientation effects are examined, along with the effects of energetically inelastic collisions. We find asymptotically closed channels to be unimportant, but the rigid rotor approximation breaks down in calculating the Raman line shifts due to the vibration-rotation interaction. This effect is accounted for by assuming different radial potentials $V_0(R)$ for scattering in two spectroscopic (vibrational) states. We find a potential that can accurately fit all the experimental data as well as the theoretical calculations of the long- and short-range behavior of the intermolecular potential. (auth)

25659 CALCULATION OF THE FUNDAMENTAL TERM $X^1\Sigma_g^+$ OF THE HELIUM QUASIMOLECULAR DOUBLY CHARGED ION He_2^{++} BY A SIMPLE METHOD. Kereselidze, T. M.; Firsov, O. B. (Inst. of Atomic Energy, Moscow). Zh. Eksp. Teor. Fiz.; 65: No. 1, 98-101(Jul 1973). (In Russian).

A simple method is proposed for calculating the fundamental term $X^1\Sigma_g^+$ of the He_2^{++} quasimolecular. It is shown that the He_2^{++} molecule possesses several quasistationary levels. (auth)

Positronium, Muonium, and Muonic and Mesic Atoms and Molecules

25660 EFFECT OF CHEMISORBED WATER ON THE MAGNETIC QUENCHING OF ORTHOPOSITRONIUM IN SILICON DIOXIDE POWDERS. Steldt, F. R.; Varlashkin, P. G. (Department of Physics and Astronomy, Louisiana State University, Baton Rouge, Louisiana 70803). Phys. Rev. B 7: No. 7, 3394-3396 (1 Apr 1973).

Positron-annihilation angular-correlation measurements have been made on compressed pellets of powdered SiO_2. The results show an anomolously strong magnetic quenching of orthopositronium which disappears with the removal of chemisorbed water. (auth)

25661 CALCULATION OF THE ENERGY LEVELS OF HYDROGEN MESIC MOLECULES BY TAKING INTO ACCOUNT ADIABATIC CORRECTIONS FOR NUCLEAR MOTION. Ponomarev, L. I.; Puzynin, I. V.; Puzynina, T. P. (Joint Inst. for Nuclear Research, Dubna, USSR). Zh. Eksp. Teor. Fiz.; 65: No. 1, 28-34(Jul 1973). (In Russian).

The binding energy of all known vibrational levels of the hydrogen mesic molecules: ppμ, ddμ, ttμ, pdμ, ptμ and dtμ are calculated. A new vibrational level $\nu = 1$ with a low binding energy $\epsilon = 0.7$ eV is found for the ddμ-mesic molecule in the state with an angular momentum $L = 1$. First order adiabatic corrections to the nuclear motion are taken into account in the calculations. (auth)

25662 OBSERVATION OF THE NEGATIVE INDUCTION EFFECT BY BOUND HYDROGEN CAPTURE OF π^--MESONS. Vil'gel'mova, L.; Zimrot, P.; Petrukhin, V. I.; Risin, V. E.; Smirnova, L. M.; Suvorov, V. M.; Yutalandov, I. A. (Joint Inst. for Nuclear Research, Dubna, USSR). Zh. Eksp. Teor. Fiz.; 65: No. 1, 24-27(Jul 1973). (In Russian).

A negative induction effect in methane and benzene derivatives is observed on basis of suppression of the probability of π^--meson capture by hydrogen, ϵ. A linear dependence of the suppression ϵ on the induction constants of the substituents σ_I is observed for the methyl derivatives. No correlation of this type is observed in the benzene derivatives which probably is due to the contribution of conjugation effects to the suppression of ϵ. (auth)

Collision Phenomena

Refer also to abstracts 24328 and 26188.

25663 (CALT-767-P-4-119) DESCRIPTION OF H_2 AND D_2 SCATTERING OFF OTHER MOLECULES BY CENTRAL FIELD POTENTIALS. Coggiola, M. J.; Gordon, R. J.; Kuppermann, A. (California Inst. of Tech., Pasadena. Arthur A. Noyes Lab. of Chemical Physics). [nd]. 2p. (CONF-730709-2). Dep. NTIS $3.00.

From 8th international conference on the physics of electronic and atomic collisions; Belgrade, Yugoslavia (16 Jul 1973).

Differential elastic scattering cross sections were measured for the systems $H_2 + O_2$, SF_6, NH_3, CO, and CH_4 and for $D_2 + O_2$, SF_6, and NH_3 using crossed molecular beams. Rapid quantum oscillations were resolved allowing the determination of central-field intermolecular potentials. These potentials were found to be independent of their assumed mathematical form, of the isotopic hydrogen molecule used, and of the de Broglie wave length of the collision. It is concluded that a spherically symmetric central-field potential is adequate for describing the elastic scattering of these systems. (JFP)

25664 (CALT-767-P-4-120) TIME DELAYS, PHASE BEHAVIOR, AND RESONANCES IN THE COLLINEAR $H + H_2$ EXCHANGE REACTION. Schatz, G. C.; Kuppermann, A. (California Inst. of Tech., Pasadena. Arthur A. Noyes Lab. of Chemical Physics). 1972. 2p. (CONF-730709-3). Dep. NTIS $3.00.

From 8th international conference on the physics of electronic and atomic collisions; Belgrade, Yugoslavia (16 Jul 1973).

The phases, lifetimes, and reaction probabilities with their resonant behavior are calculated as a function of the energy for the collinear $H + H_2$ reaction. It is found that both direct and resonant processes contribute to the reaction and that the relative importance of these processes as well as phase interferences between the two can be crucial in determining the energy dependence of the reaction probabilities. (JFP)

25665 (JINR-E7-7237) HYPERFINE INTERACTIONS OF HEAVY IONS RECOILING INTO VACUUM. Balanda, A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1973. 16p. Dep. NTIS (U. S. Sales Only) $3.00.

An approximate description of the attenuation coefficients $G_k(t)$ by means of a mixed, time-dependent and static interaction is discussed. As an illustration, an analysis of experimental results is presented. (auth)

25666 (KFKI-73-22) NON-PERTURBATIVE APPROACHES TO THE SEMICLASSICAL THEORY OF MULTIPHOTON IONISATION. Bergou, J. A. (Magyar Tudomanyos Akademia Kozponti Fizikai Kutato Intezete, Budapest). 1973. 6p. Dep. NTIS (U. S. Sales Only) $3.00.

Within the framework of the semiclassical theory a general foundation of nonperturbative calculations is given for the multiphoton probability—using the formal time dependent theory of scattering. From the general expression of the transition probability it is shown that the most important two nonperturbative methods—the momentum translational method and the method of Keldysh—are nearly equivalent, and a comparison of their results is given. (auth)

25667 (ORNL-4897) CROSS SECTIONS FOR ATOMIC DISPLACEMENTS IN SOLIDS BY FAST ELECTRONS. Oen, O. S. (Oak Ridge National Lab., Tenn.). Aug 1973. Contract W-7405-eng-26. 207p. Dep. NTIS $7.60.

The Mott series is used to calculate the number of displacements produced in elastic collisions between fast electrons and atomic nuclei. Displacement cross sections of 37 different elements spanning the atomic table were calculated for electron energies ranging from threshold to about 150 MeV. The Kinchin and Pease model was used with atomic thresholds ranging from 4 to 96 eV in steps of 4 eV. The results are compared with those using the less accurate McKinley-Feshbach formula frequently used in radiation damage studies. In addition, tables giving the differential scattering cross sections in 5° intervals for both the Mott series and the McKinley-Feshbach formula are included. (auth)

25668 (RLO-1388-221, pp 134-136) AUGER SPECTRA IN HEAVY-ION COLLISIONS. Burch, D.; Harris, J.; Ingalls, W. B.; Risley, J. S. Jun 1973.

In annual report, 1973.

25669 (RLO-1388-221, pp 138-139) K-SHELL IONIZATION IN $Ne^+ + Ne$ COLLISIONS. Burch, D.; Schneider, D.; Stolterfoht, N. Jun 1973.

In annual report, 1973.

25670 (RLO-1388-221, pp 140-141) ELECTRON LOSS IN HIGH-ENERGY OXYGEN-ION COLLISIONS. Burch, D.; Ingalls, W. B.; Wieman, H. Jun 1973.

In annual report, 1973.

25671 (RLO-1388-221, pp 141-143) OUTER-SHELL EXCITATION OF THE RARE GASES BY 30-MeV OXYGEN IONS. Bickel, W. S.; Burch, D.; Harris, J.; Ingalls, W. B.; Risley, J. S.; Wieman, H. Jun 1973.

In annual report, 1973.

25672 IONIZATION OF ATOMS IN RADIATIVE COLLISIONS. Yakovlenko, S. I. (Inst. of Atomic Energy, Moscow). Zh. Eksp. Teor. Fiz.; 64: No. 6, 2020-2027(Jun 1973). (In Russian).

Resonance processes occurring in collisions between atoms in a monochromatic external field are considered. Transfer of excitation from atom to atom with simultaneous quantum absorption (radiative collision) is considered in the case when the quantum energy is "sufficient" for photoionization of the excited atom. Expressions for the radiative collision cross section are obtained when transfer of excitation from atom to atom or transfer of excitation with subsequent atom ionization occur. The efficiencies of these reactions are compared with that of direct photoionization of an excited atom. The results of experiments are discussed from the viewpoint of these processes. (auth)

25673 COMPOSITION OF THE SLOW IONS PRODUCED ON IONIZATION OF GASES BY HIGH ENERGY PROTONS. Levchenko, Yu. Z.; Pivovar, L. I.; Tolstolutskaya, G. D. (Physical Technical Inst., Kharkov). Zh. Eksp. Teor. Fiz.; 64: No. 6, 1991-1996(Jun 1973). (In Russian).

A systematic investigation is carried out on the charge distributions of slow ions produced in single collisions of 0.2 to 1.8 MeV protons in He, Ne, Ar, Kr, H_2 and N_2 gases. It is shown that for all singly charged slow positive ions the energy dependence of the cross sections is in accordance with the Bethe–Born theory. Deviations from the theory are observed for the partial cross sections of multi-charged ions. Some suggestions regarding the nature of the deviations are made. (auth)

25674 L- AND M-SHELL PHOTOELECTRIC CROSS SECTIONS OF GAMMA RAYS IN Pt. Rao, K. S.; Rao, B. V. T.; Rao, B. M.; Parthasaradhi, K. (Andhra Univ., Waltair, India). Indian J. Pure Appl. Phys.; 11: No. 3, 217(Mar 1973).

L- and M-shell photoelectric cross sections of gamma rays in Pt at energies of 60, 145 and 320 keV are determined. Satisfactory agreement is observed within the range of errors with the theoretical values reported by R. D. Schmickley and R. H. Pratt [Tables of calculated photoelectric cross sections for energies 10–3000 keV (Lockheed Palo Alto Research Laboratories), 1967]. (auth)

25675 INTERPRETATION OF THE ENERGY LOSSES EXPERIENCED BY AUGER ELECTRONS EMITTED UNDER ION BOMBARDMENT. Benazeth, C.; Viel, L.; Colombie, N. (Univ. Toulouse). Compt. Rend., Ser. A, B; 276: No. 23, 863-866(4 Jun 1973). (In French).

The fine structure observed in the energy spectrum of the secondary electrons emitted as a result of ion bombardment with light elements (or compounds of these elements) can be interpreted in terms of Auger transitions and characteristic energy losses. The energy losses are considered to be due to the excitation of the 3s shell of the elements studied. This type of excitation loss leads to values which are in agreement with experiment. (auth)

25676 ENERGY DISTRIBUTION OF SECONDARY IONS. Blaise, G.; Slodzian, G. (Paris Univ., Orsay, France). Rev. Phys. Appl.; 8: No. 2, 105-116(Jun 1973). (In French).

The energy distribution of secondary ions was analyzed using a counter-field method which utilized an electrostatic mirror provided with an ion micro-analyzer. The results presented concern M^+ and M_n^+ ions from metals and alloys bombarded with primary Ar^+ ions. Emphasis is put on the very different aspects of the low energy (less than about 20 eV) ion distributions. (auth)

25677 AUTOIONIZATION SPECTRA OF POSITRONS IN HEAVY-ION COLLISIONS. Peitz, H.; Mueller, B.; Rafelski, J.; Greiner, W. (Univ., Frankfurt am Main). Lett. Nuovo Cim.; 8: No. 1, 37-42(1 Sep 1973).

The width for spontaneous positron emission and the differential cross section for positron production in the heavy-ion scattering process is given. The total positron production cross section is $2.8(10)^{-5}$b for U–U, $2.5(10)^{-4}$b for U–Cf, and 10^{-3}b for Cf–Cf. It is found that the shape of the excitation function of the autoionization positrons produced in over-critical fields occurring in very heavy-ion collisions and the magnitude of the cross section are favorable for experimental observation. (JFP)

25678 ELECTRON LOSS IN HIGH-ENERGY OXYGEN-ION COLLISIONS. Burch, D.; Wieman, H.; Ingalls, W. B. (Department of Physics, University of Washington, Seattle, Washington, 98195). Phys. Rev. Lett. 30: No. 18, 823-826 (30 Apr 1973).

The 90° electron spectra from oxygen-ion single collisions with Ar have been measured at energies of 17 to 41 MeV and charge states of 3+ to 8+. A broad peak in the spectra is observed and identified as electrons lost from the incident ion. A simple model of the electron-loss process is described which supports the identification. (auth)

25679 DETERMINATION OF THE He^4-He^4 REPULSIVE POTENTIAL UP TO 0.14 eV BY INVERSION OF HIGH-RESOLUTION TOTAL-CROSS-SECTION MEASUREMENTS. Feltgen, R.; Pauly, H.; Torello, F.; Vehmeyer, H. (Max-Planck-Institut für Strömungsforschung, Göttingen, Germany). Phys. Rev. Lett. 30: No. 18, 820-823 (30 Apr 1973).

High-resolution measurements of the He^4-He^4 total scattering cross section are presented for reduced collision energies between 0.2 and 200 meV. Clear evidence for the Ramsauer-Townsend effect is observed and thirteen backward glory extrema are resolved. From these extrema we derive the energy dependence of the s phase shift. Applying the semiclassical inversion method proposed by Miller we then compute the repulsive potential up to 0.14 eV. (auth)

25680 SCATTERED-ION-X-RAY COINCIDENCES IN Ar^+-Ar COLLISIONS; DEPENDENCE OF Ar L-X-RAY YIELD ON FINAL CHARGE STATE. Thoe, R. S.; Smith, W. W. (Department of Physics, The University of Connecticut, Storrs, Connecticut 06268). Phys. Rev. Lett. 30: No. 12, 525-528 (19 Mar 1973).

Coincidence measurements made of $L_{2,3}M$ x-ray yield versus scattered-ion final charge state in differential Ar^+-Ar scattering at keV energies are compared with theoretical fluorescence-yield calculations by Bhalla and Walters and by Larkins. Enhancement of the fluorescence yield at $\theta_{lab}=20°$ is found for energies of 20 keV and above due to excitation of the Ar M shell. (auth)

25681 ELECTRON IMPACT IONIZATION CROSS SECTIONS OF Cu AND Au BETWEEN 40 AND 250 eV, AND THE VELOCITY OF EVAPORATED ATOMS. Schroeer, J. M.; Guenduez, D. H.; Livingston, S. (Department of Physics, University of Wyoming, Laramie, Wyoming 82070/Department of Physics, Illinois State University, Normal, Illinois 61761). J. Chem. Phys.; 58: No. 11, 5135-5140(1 Jun 1973).

The total ionization cross sections of Cu and Au were measured with a simple crossed-beam apparatus for bombarding electron energies between 40 and 250 eV. The maximum cross sections were σ (Cu) = $(7.6 \pm 1.1)\times10^{-16}$ cm^2 at 95±10 eV and σ (Au) = $(15.3\pm2.1)\times10^{-16}$ cm^2 at 100±10 eV. The ratio of the cross sections is σ (Au)/σ (Cu) $=2.0\pm0.2$ between 50 and 180 eV. The shape of our cross section curve for Cu compares well with a previous measurement by Crawford. An evaporation model which predicts thermal equilibrium between a liquid and the atoms evaporating into a vacuum is discussed, and the average velocity of atoms evaporated from an evaporation boat is calculated. (auth)

25682 SEMICLASSICAL APPROXIMATIONS FOR SCATTERINGS BY NONLOCAL POTENTIALS: I. THE EFFECTIVE-MASS METHOD. Gerber, R. B. (Department of Chemical Physics, the Weizmann Institute of Science, Rehovot, Israel). J. Chem. Phys. 58: No. 11, 4936-4948 (1 June 1973).

A semiclassical theory for the scattering of a particle by a nonlocal potential is developed with the purpose of applying it to several aspects of atomic collisions. The scheme that we construct is based on the replacement of the Hamiltonian with the nonlocal interactions by an approximate Hamiltonian that includes a certain local potential and an effective mass that depends on the distance of the particle from the origin of the potential. This is followed by the introduction of either the JWKB or the Eikonal approximation in the form familiar in potential scattering theory. The dependence of the approximate semiclassical wavefunctions and phase shifts on the effective mass is studied and effects owing to the variation of the latter quantity with the coordinates are discussed. A treatment is provided for cases where the effective mass has a zero or a pole. Appropriate "connection formulas" are derived for the determination of the correct JWKB solution in regions that lie in the neighborhood of points at which such a zero or a singularity occurs. It is pointed out that zeros of the effective mass can lead to pronounced resonances and to barrierlike effects. Since any multichannel collision process can be discussed in terms of equivalent one-body equations involving nonlocal potentials, the semiclassical scheme we develop is applicable to inelastic and rearrangement processes as well as to elastic ones. Applications of this method to atomic collision theory will be described in a forthcoming publication. (auth)

25683 SEMICLASSICAL APPROXIMATIONS FOR SCATTERING BY NONLOCAL POTENTIALS. II. Simple Applications to Atomic Collisions. Gerber, R. B. (Department of Chemical Physics, The Weizmann Institute of Science, Rehovot, Israel). J. Chem. Phys.; 58: No. 11, 4949-4961(1 Jun 1973).

The effective-mass method for treating scattering by nonlocal potentials described in a previous publication is applied to some problems in atomic collision theory. The applications are based on an effective equation for scattering in the elastic channel when coupling with other channels is included, giving rise to a nonlocal effective potential. We use the effective-mass theory to analyze the influence of coupling with closed channels on the elastic scattering in atom-atom collisions, and point out that this may lead to a new type of rainbow effect. We show that strong interchannel coupling results in the appearance of poles and zeros in the effective mass and that the latter may lead to compound-state resonances and orbiting effects. It is observed that the occurrences of Feshbach resonances in molecular encounters is always reflected in the presence of zeroes in the corresponding effective mass. We also employ the effective-mass method to deal briefly with the familiar problem of curve crossing and nonadiabatic transitions in atomic collisions. (auth)

25684 NEGATIVE-CHARGE PRODUCTION BY HYDROGEN ATOMS IN Ar, Kr, Xe, CO, CO_2, AND CH_4 IN THE ENERGY RANGE 80-2000 eV. Dehmel, R. C.; Meger, R.; Fleischmann, H. H. (School of Applied and Engineering Physics and Laboratory for Plasma Studies, Cornell University, Ithaca, New York 14850); Steinberg, M. J. Chem. Phys. 58: No. 11, 5111-5115(1 June 1973).

Experimental cross sections for negative-charge production by neutral hydrogen atoms in the energy range 80eV-2keV in Ar, Kr, Xe, CO, CO_2, and CH_4 are reported. In all cases, a smooth increase of the cross section with energy is observed, from values of about 10^{-17} cm^2 at 80 eV to a few times 10^{-16} cm^2 at 2kev. (auth)

25685 THERMAL DISSOCIATION AND RECOMBINATION OF HYDROGEN ACCORDING TO THE REACTIONS $H_2+H=H+H+H$. Shui, V. H. (Department of Mechanical Engineering, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). J. Chem. Phys. 58: No. 11, 4868-4879 (1 June 1973).

Three-body recombination and dissociation rate coefficients (k_r and k_d, respectively) for the reactions $H_2+H=H+H+H$ have been evaluated for temperatures ranging between 300 and 10 000°K on the basis of the modified phase-space theory of reaction rates and Monte Carlo trajectory calculations. The semiempirical Porter-Karplus surface for H_3 was used in the calculations. Good agreement was obtained between the theoretical estimates of k_d and the bulk of the dissociation rate measurements. However, in contradistinction to some of the recent experimental investigations, neither the extremely steep temperature decay ($\sim T^{-6}$) of k_r at high temperatures nor the existence of a pronounced maximum in k_r at moderate temperatures are supported by this theoretical work. Possible reasons for these differences are suggested. A simple ratio was deduced which relates $k_r^{(H)}$ and the corresponding rate coefficients of the isotopes of hydrogen. The result is in good agreement with available experimental measurements and enables one to predict the latter rate coefficients without additional trajectory calculations. An example is given to illustrate the capability of the present Monte Carlo method in obtaining other useful information about atomic and molecular collision processes. (auth)

25686 OPTICAL STUDY OF CHARGE EXCHANGE COLLISIONS BETWEEN He^+ AND CO_2. Coplan, M. A. (Institute for Fluid Dynamics and Applied Mathematics, University of Maryland, College Park, Maryland 20742); Mentall, J. E. J. Chem. Phys. 58: No. 11, 4912-4915 (1 June 1973).

The optical emission between 2800 and 5000 Å resulting from collision of He^+ with CO_2 has been investigated over a range of ion energies from 200 to 1500 eV. The strongest emission was in the CO_2^+ $A\,^2\Pi$-$X\,^2\Sigma_g$ band system which was found to have a cross section of 4×10^{-17} cm^2 at ∼200 eV. An upper limit for the cross section for the production of excited CO^+ was determined to be of the order of 8×10^{-18} cm^2. Two triplet lines of He were also observed with cross sections on the order of 10^{-19} cm^2. (auth)

25687 ABSOLUTE TOTAL CROSS SECTIONS FOR Li-MOLECULE SCATTERING. Dehmer, P.; Ury, G.; Wharton, L. (Department of Chemistry and James Franck Institute, The University of Chicago, Chicago, Illinois 60637). J. Chem. Phys. 58: No. 11, 4724-4732 (1 June 1973).

Absolute total scattering cross sections were measured for ^7Li scattered by D_2, N_2, CO, CO_2, CH_4, and SF_6 over a range of Li beam velocities of $0.75\text{–}4.75\times10^5$ cm/sec corresponding to a range of relative kinetic energies of 0.04–0.33 eV for Li–D_2 to 0.02–0.79 eV for Li–SF_6. In the observed cross sections random experimental errors were less than 1.5% and systematic errors were between –0.3% and +1.4%. Two spherically symmetric potentials, the Lennard-Jones (12,6) and the Buckingham-Corner were fit to deconvoluted and statistically smoothed data using a non-linear least squares fitting routine. For each Li-molecule system a satisfactory fit could be obtained with standard deviations of approximately 1%–2%. The best fit potentials gave accurate values for the average long range attractive part of the potentials over the range of limiting impact parameters. Evidence from high resolution differential cross section experiments is introduced that indicates that there should be relatively little damping of the glory features of the total scattering cross sections for the Li-molecule systems studied here, and hence the ability of spherical potentials to reproduce the data is not surprising. (auth)

25688 KINETIC STUDY OF ELECTRONICALLY EXCITED PHOSPHORUS ATOMS, $P(3^2D_J, 3^2P_J)$, BY ATOMIC ABSORPTION SPECTROSCOPY. II. Acuna, A. U.; Husain, D.; Wiesenfeld, J. R. (The Department of Physical Chemistry, The University of Cambridge, Lensfield Road, Cambridge CB2 1EP, England). J. Chem. Phys. 58:

No. 12, 5272-5279 (15 June 1973).

Electronically excited phosphorus atoms in the $P(3^2D_J)$ and $P(3^2P_J)$ states have been generated in the gas phase by pulsed photolytic irradiation and monitored by means of absorption spectroscopy using attenuation of atomic resonance radiation. The kinetic decay of these two low-lying, optically metastable states has been studied in the presence of the following collision partners: Ar, Kr, Xe, N_2, CO, NO, Co_2, N_2O, PCl_3, CH_4, and C_2H_4, and second-order constants are reported for the removal processes at 300°K. (auth)

25689 CROSS SECTION FOR M-SHELL IONIZATION IN HEAVY ATOMS BY COLLISION OF SIMPLE HEAVY CHARGED PARTICLES. Choi, B. (University of North Carolina at Chapel Hill 27514). Phys. Rev. A 7: No. 6, 2056-2062 (June 1973).

The cross sections for M-shell electron ionization by direct Coulomb excitation of heavy target atoms by incident heavy charged particles are evaluated. Incident particles are described in the plane-wave Born approximation, and screened hydrogenic wave functions are used for the atomic electrons. Numerical results are given for Au, U, and No, and the theory is compared with experimental data for Ho as an illustration. Explicit expressions for the absolute values of the M-subshell form factors of bound-free transitions are presented as functions of momentum and energy transfers. The results are discussed. (auth)

25690 MULTIPLE-SCATTERING EXPANSIONS FOR NONRELATIVISTIC THREE-BODY COLLISION PROBLEMS. VIII. EIKONAL APPROXIMATION FOR THE FADDEEV-WATSON MULTIPLE-SCATTERING EXPANSION. Chen, J. C. Y.; Lars Hambro; Sinfailam, A. (Department of Physics and Institute for Pure and Applied Physical Sciences, University of California, San Diego, La Jolla, California 92037); Chung, K. T. Phys. Rev. A 7: No. 6, 2003-2009 (June 1973).

The Faddeev-Watson multiple-scattering (FWMS) expansion is investigated in the eikonal approximation. For the case with the classical trajectories taken to lie along straight lines, the second-order FWMS expansion reduces to the well-known Glauber-eikonal approximation. Application of the second-order FWMS expansion in the eikonal approximation is carried out for elastic and inelastic (e,H) scattering with the classical trajectories taken as intersecting two straight-line segments. The result suggests that there is a substantial cancellation between the first-order and second-order terms in the FWMS expansion for pair Coulomb interactions. (auth)

25691 COINCIDENCE MEASUREMENTS OF Ar^+-Kr COLLISIONS AT keV ENERGIES. Del Boca, R. L.; Montgomery, J. W.; Hayden, H. C. (Physics Department, University of Connecticut, Storrs, Connecticut 06268). Phys. Rev. A 7: No. 6, 1994-2002 (June 1973).

The coincidence technique of Kessel and Everhart has been used to study the $Ar^+ + Kr \rightarrow Ar^{+m} + Kr^{+n} + (m+n-1)e$ reaction at incident ion energies from 15 to 230 keV, and scattering angles from 10° to 40°, corresponding to distances of closest approach ranging from 0.38 to 0.06 Å. Q values varied from less than 100 eV to greater than 3 keV, and the average numbers of ejected electrons varied from 1/2 to 7/2 for argon and from 5/2 to 8 for krypton. Unresolved Q structure is probably present at 0.2 to 0.3 Å. As with all previous data which the authors have handled where the Q_{mn} profiles are not multiply peaked, the Ar^+-Kr Q values were found to be fit by the empirical relation $Q_{mn} = Ar + BU_m + CU_n$ where the U's are spectroscopic energy deficits, with rms errors averaging about 5/2. Several indirect means show that the krypton is responsible for some 65% of the energy loss, possible decreasing to about 55% at the highest Q_{mn} values studied. The intrinsic ionization probabilities inferred from the present study reproduce fairly well the probabilities from previous Ar^+-Ar and Kr^+-Kr studies. (auth)

25692 ELECTRON SCATTERING WITH AND WITHOUT VIBRATIONAL EXCITATION. VIII. COMMENT ON A THEORY OF SMALL-ENERGY-TRANSFER COLLISIONS DOMINATED BY LONG-RANGE FORCES. Truhlar, D. G. (Chemical Dynamics Laboratory, University of Minnesota, Minneapolis, Minnesota 55455). Phys. Rev. A 7: No. 6, 2217-2219 (June 1973).

Two methods [D. G. Truhlar and J. K. Rice, J. Chem. Phys. 52 4480 (1970) and B. Ritchie, Phys. Rev. A 6, 1456 (1972)] for calculating cross sections for vibrational excitation of molecules by electron impact are compared. The former method is shown to have a greater range of applicability. Cross sections computed by the two methods differ by about a factor of 2 for excitation to the first vibrationally excited level of H_2. The neglect of the short-range potential in Ritchie's method is shown to be an important source of error in that method. (auth)

25693 PERTURBED STATIONARY-STATE THEORY OF ATOMIC INNER-SHELL IONIZATION BY HEAVY CHARGED PARTICLES. Basbas, G.; Brandt, W.; Ritchie, R. H. (Department of Physics, New York University, New York, New York 10003). Phys. Rev. A 7: No. 6, 1971-1976 (June 1973).

Cross sections for inner-shell ionization by slow heavy charged particles, if compared to predictions given in the plane-wave Born approximation, are reduced strongly by the Coulomb deflection of the particle in the field of the target nucleus, and by the increase in binding energy of the target electrons induced by the presence of the particle. We use the framework of the perturbed-stationary-state approximation to incorporate these effects ab initio into the theory of inner-shell ionization and derive the binding effect given by Brandt, Laubert, and Sellin. Our result formally unifies the Coulomb deflection of the particle trajectory with the perturbation of the atomic states in their effect on the ionization cross section and suggests systematic ways for further improvements. (auth)

25694 SELF-CONSISTENT-FIELD CALCULATIONS FOR THE ELASTIC SCATTERING OF ELECTRONS FROM HYDROGENLIKE SYSTEMS. Soukup, G. A. (Department of Physics, The University of Chicago, Chicago, Illinois 60637). Phys. Rev. A 7: No. 6, 1944-1957 (June 1973).

A general formalism is presented for the description of elastic scattering of electrons from hydrogenlike atomic systems. The total wave function for the two-electron system is put forth as a multiconfiguration expansion in terms of suitably normalized orthogonal orbitals. These radial orbitals as well as the coefficients of the expansion are determined variationally via a system of coupled integrodifferential equations. The formalism is applied to the calculation of elastic electron-hydrogen scattering in the energy range below the first resonance for the ^1S state of the two-electron system. Accurate phase shifts are obtained with short expansions, as the newly introduced orbitals obtained by numerically integrating the integrodifferential equations account quite adequately for short-range correlation. (auth)

25695 K-SHELL IONIZATION OF INTERMEDIATE- AND HIGH-Z ELEMENTS BY ALPHA PARTICLES. Hardt, T. L.; Watson, R. L. (Department of Chemistry and Cyclotron Institute, Texas A&M University, College Station, Texas 77843). Phys. Rev. A 7: No. 6, 1917-1927 (June 1973).

K x-ray yields have been measured for ten elements ranging from Fe ($Z = 26$) to Au ($Z = 79$) using 30-100-MeV α particles. The new data were combined with some earlier measurements and a smooth-curve fit was performed on the x-ray production cross sections plotted as a function of target atomic number. These "smoothed" cross sections were used in comparisons with the predictions of plane-wave-Born-approximation (PWBA) and binary-encounter-approximation (BEA) calculations and resulted in the observation of a systematic atomic-number-dependent deviation between experiment and theory. By comparing the measured cross-section data to the universal BEA curve at velocity ratios in which the mean electron velocity was calculated "semi-"relativistically, over-all agreement within $\pm$ 16% was attained for all elements studied. (auth)

25696 AUGER SPECTRA OF CARBON AND ARGON FOLLOWING IONIZATION BY EQUAL-VELOCITY α PARTICLES AND DEUTERONS. Watson, R. L. (Department of Chemistry and Cyclotron Institute, Texas A&M University, College Station, Texas 77843); Toburen, L. H. Phys. Rev. A 7: No. 6, 1853-1863 (June 1973).

The spectra of carbon K- and argon L-shell Auger electrons resulting from ionization produced by 0.15-0.50-MeV/amu α particles and deuterons incident on a thin gas cell have been measured. Absolute ionization cross sections were obtained from the Auger-electron yields and, in addition, the yields obtained with equal-velocity projectiles were used to test the projectile z dependence of the ionization process. Intense satellite structure was observed in the Auger spectra and these features were attributed to Auger transitions from multiple vacancy states formed during the collision. (auth)

25697 MOMENTUM TRANSFER AND TOTAL SCATTERING CROSS SECTIONS FOR IONS WITH POLAR MOLECULES. Dugan, J. V. Jr. (NASA Lewis Research Center, Cleveland, Ohio 44135); Magee, J. L. J. Chem. Phys. 58: No. 12, 5816-5823 (15 June 1973).

The scattering of ions by polar molecules has been studied using numerical techniques. Because of the long range potential of interaction the scattering cross sections are very large. The total scattering cross section and rotational energy transfer cross section are of the order of thousands of $Å^2$ for the cases studied. The momentum transfer cross sections are 1.3 to 2.0 times the capture cross sections in contrast to the $\sigma_m/\sigma_c = 1.105$ for Langevin collisions. However, the scattered intensity $I(\theta)$ at impact parameters less than 20Å can be quite anisotropic because of the nature of single reflection collisions. (auth)

25698 VARIATIONAL CALCULATIONS OF ELECTRON-ALKALI-METAL-ATOM SCATTERING. I. ELASTIC SCATTERING BY Li, Na, AND K. Sinfailam, A. L.; Nesbet, R. K. (IBM Research Laboratory, San Jose, California 95193). Phys. Rev. A 7: No. 6, 1987-1994 (June 1973).

Elastic total and spin-exchange cross sections are computed for electron scattering by Li, Na, and K, for energies below the first excitation threshold. The method used is the variational form of solution

of continuum Bethe–Goldstone equations. Results are in substantial agreement with close-coupling calculations and with recent experimental data. (auth)

25699 FORMATION OF FAST EXCITED H ATOMS INDUCED BY IMPACT OF H^+, H_2^+, AND H_3^+ ATOMS ON MOLECULAR AND NOBLE-GAS TARGETS. Conrads, R. J.; Nichols, T. W.; Ford, J. C.; Thomas, E. W. (School of Physics, Georgia Institute of Technology, Atlanta, Georgia 30332). Phys. Rev. A 7: No. 6, 1928-1935 (June 1973).

An experimental investigation has been made of the formation of excited hydrogen atoms by charge-transfer neutralization of H^+ and collisional dissociation of H_2^+ and H_3^+. Data are presented for the formation of H(3s) induced by H^+, H_2^+, and H_3^+ impact on the noble gases; for H_2^+ impact on H_2, D_2, N_2, and Ar, the measurements include formation of H(3s) and H(3d) states. Projectile energies range from 100 to 600 keV. The cross sections for producing hydrogen in the n = 3 states have been determined by quantitative measurement of collisionally induced Balmer-α emission. The contributions from the 3s, 3p, and 3d states were separated by a method employing the different lifetimes of each state. Data are consistent with previous measurements made at lower energies. In dissociation the cross sections are generally the same for the formation of the 3s and 3d states; they show a slow decrease as a function of projectile energy. Cross sections for formation of H(3s) by charge transfer show the expected rapid decrease with increasing energy. Differences between cross sections for various target gases suggest that the internal structure of the target atom will be an important factor in any prediction of these cross sections. (auth)

25700 GLORY SCATTERING IN MOLECULAR COLLISIONS. III. COLLISIONS BETWEEN INDISTINGUISHABLE MOLECULES. Biolsi, L. (Department of Chemistry, University of Missouri–Rolla, Rolla, Missouri 65401). J. Chem. Phys. 58: No. 12, 5331-5338 (15 June 1973).

An extended distorted-wave treatment is used to obtain formal expressions for the total cross section when two indistinguishable rigid diatomic molecules, with orbital and nuclear spin angular momenta, collide. Explicit expressions for the cross section are obtained through second order, including the lowest order inelastic effects. An expression for the total inelastic cross section is also given. The results are compared with the corresponding results when distinguishable molecules collide. (auth)

25701 COLLISION-INDUCED ION PAIR FORMATION OF THALLIUM HALIDES: THRESHOLD BEHAVIOR. Parks, E. K.; Wagner, A.; Wexler, S. (Chemistry Division, Argonne National Laboratory, Argonne, Illinois 60439). J. Chem. Phys. 58: No. 12, 5502-5513 (15 June 1973).

The threshold laws for direct polar dissociation $A + BC \rightarrow A + B^+ + C^-$ and for ion-complex formation $A + BC \rightarrow AB^+ + C^-$ are determined for the collision of Xe and Kr atoms with TlCl, TlBr, and TlI by analysis of the experimental excitation functions presented in the preceding paper. The cross section for direct polar dissociation is parameterized by the expression $A(E_{tot} - E_0)^n/E_{rel}$, where E_{tot} and E_{rel} are the total energy and the relative translational energy, respectively, of the reactants, and E_0 is the threshold energy. The cross section is averaged over the experimental translational and internal energy distributions, and, for each pair of reactants, E_0, n, and A are determined from the best fit to the data. For ion-complex formation, the data are analyzed in terms of a step behavior at the reaction threshold. For the system Xe + TlCl, experimental measurements of the cross section as a function of internal energy are presented, and the relative importance of translational and internal energy in promoting polar dissociation is discussed. It is found that an increment of internal energy is more effective in promoting polar dissociation than an equal increment of translational energy. (auth)

25702 EFFECT OF THE POTENTIAL WELL ON VIBRATIONAL SCATTERING AND THE VALIDITY OF SSH THEORY. Wagner, A. F.; McKoy, V. (Arthur A. Noyes Laboratory of Chemical Physics, California Institute of Technology, Pasadena, California 91109). J. Chem. Phys. 58: No. 12, 5561-5569 (15 June 1973).

The vibrational de-excitation probability, P_{10}, is calculated quantum mechanically over a large energy range for models of three collision systems: O_2–O_2, Cl_2–Cl_2, and Br_2–Br_2. The vibrational de-excitation cross section, σ_{10}, is similarly calculated for the Cl_2–Cl_2 model. P_{10} and σ_{10} are obtained for the Lennard-Jones intermolecular potential and three other "well-less" potentials designed to duplicate the scattering of the Lennard-Jones potential. The results emphasize the adiabatic nature of potentials with wells and indicate that the acceleration approximation for the effect of the well is not valid. The curves of P_{10} and σ_{10} as a function of initial translational energy are used to obtain exact collision numbers. These numbers are compared to the results of SSH theory. SSH theory is found to predict collision numbers with reasonable accuracy except at low temperatures. SSH theory is also not suitable for analyzing experimental collision numbers for the well depth potential parameter. (auth)

25703 THREE-ATOM SCATTERING IN GAS-PHASE ELECTRON DIFFRACTION. II. A GENERAL TREATMENT. Wong, T. C.; Bartell, L. S. (Department of Chemsitry, the University of Michigan, Ann Arbor, Michigan 48104). J. Chem. Phys. 58: No. 12, 5654-5660 (15 June 1973).

Intramolecular multiple scattering of electrons by polyatomic gas molecules is investigated with the aid of Glauber's theory of high energy elastic scattering. The key to a simpler and more rapidly convergent expression for dynamic scattering corrections is found in a propitious transformation of variables. An analytical representation of the corrections averaged over molecular rotations and vibrations is presented in a form suitable for routine electron diffraction analyses of molecular structure. Magnitudes and practical considerations in analyses are briefly discussed. (auth)

25704 NEGATIVE ION REACTIONS WITH NEUTRAL OZONE. Rutherford, J. A.; Turner, B. R.; Vroom, D. A. (Gulf Radiation Technology, A Division of Gulf Energy & Environmental Systems, San Diego, California 92112). J. Chem. Phys. 58: No. 12, 5267-5271 (15 June 1973).

Charge transfer reactions between O^-, O^-_2, OH^-, and NO^-_2 and O_3 have been studied to obtain cross sections for formation of O_3^-. The charge transfer reaction O^-_3 on NO_2 has also been remeasured. The range of ion energies considered extends from 1 to 500 eV. Upper limits have been obtained for the charge transfer cross section of F^-, Cl^-, and CO_3^-, with O_3. The results show that the electron affinity of O_3 must be close to accepted value of approximately 2 eV. The method used to produce a neutral beam of pure O_3 is discussed. (auth)

25705 DYNAMICS OF THE O^+–H_2 REACTION. I. REACTIVE SCATTERING OF $O^+(^4S_{(3/2)})$ AT RELATIVE ENERGIES BELOW 15 eV. Gillen, K. T.; Mahan, B. H.; Winn, J. S. (Department of Chemistry and Inorganic Materials Research Division of the Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). J. Chem. Phys. 58: No. 12, 5373-5384 (15 June 1973).

Product velocity vector distributions show that the reaction $O^+(H_2,H)OH^+$ and its isotopic variations proceed from ground state reactants to predominantly electronic ground state products via a direct interaction. Spectator stripping is a prominent feature at the lower relative energies of collision, but the stripping peak is lost at energies where the internal excitation of $OH^+(^3\Sigma^-)$ makes it unstable to dissociation. Production of forward scattered electronically excited OH^+, probably in the $^1\Delta$ state, is observable when the initial relative energy is high enough that $OH^+(^3\Sigma^-)$ formed by spectator stripping is unstable with respect to dissociation. At these relative energies, OH^+ from HD is predominantly scattered into barycentric angles less than 90°, while the OD^+ appears at approximately 90° at larger angles. The propensity for formation of OD^+ at large angles can be understood in terms of general kinematic considerations which apply to collinear collisions. (auth)

25706 COLLISION-INDUCED ION PAIR FORMATION OF THALLIUM HALIDES: ABSOLUTE CROSS SECTIONS. Parks, E. K.; Hansen, N. J.; Wexler, S. (Chemistry Division, Argonne National Laboratory, Argonne, Illinois 60439). J. Chem. Phys. 58: No. 12, 5489-5501 (15 June 1973).

Collision-induced dissociative ion pair formation (polar dissociation) of thallium chloride, bromide, and iodide by aerodynamically accelerated Xe and Kr atoms has been studied by the crossed-beam method. Absolute cross sections for total positive ion formation from both the monomer and the dimer were determined from the threshold to several electron volts relative energy above threshold. The cross sections for the monomer varied over three orders of magnitude, ranging from 0–1.0 × 10^{-16} cm^2 for TlCl, to 0–8 × 10^{-18} cm^2 for TlBr, to 0–1.6 × 10^{-19} cm^2 for TlI when Xe was the collidant. Similar ranges were measured for Kr on TlCl and TlI, but the cross sections were approximately a factor of 10 smaller for TlBr. The observed cross sections for positive ion production from the dimer molecules were in the range of 1 to 20 × 10^{-16} cm^2. Time-of-flight mass spectrometry permitted the determination of partial cross sections for each positive and negative ion channel in the collision. The excitation functions for the reaction $A + BC \rightarrow A + B^+ + C^-$ (direct polar dissociation) exhibited a concave upward curvature in the postthreshold region, while those for $A + BC \rightarrow AB^+ + C^-$ (complex formation) showed a step behavior for TlCl and a concave downward curvature for TlBr. The yield of Tl_2X^+ was used in calculating the cross section for polar dissociation of the dimer. Only monatomic halogen negative ions were observed. The experimental results are discussed within the framework of a surface crossing model. The model predicts the essential features of the experimental results for both the thallium halide monomers and dimers. (auth)

25707 MEASUREMENT OF DIFFERENTIAL CROSS SECTIONS OF LOW-ENERGY ELECTRONS ELASTICALLY SCATTERED BY GAS MOLECULES. 1. Apparatus. Kambara, H.; Kuchitsu, K. (Tokyo Univ.). Jap. J. Appl. Phys.; 11: No. 5, 609-616(May 1972).

An electron diffractometer designed for the study of elastic scattering of a low energy electron beam by a flow of gas molecules emitted from a fine nozzle is constructed. As a check of the ac-

curacy of the measurement, relative differential cross sections for the nitrogen molecule are measured with the angular precision and resolution of about 0.3 and less than 1°, respectively. The angular distributions of the scattered electrons, measured from 4 to 150°, agree within 5% (in the relative scale) with those measured by Bromberg in the range from 5 to 110° at the incident electron energies of 300 eV and 500 eV in spite of the differences in the techniques. Similar measurements made for 100 and 50 eV electrons show minimum cross sections at about 90°. (auth)

25708 ELECTRON-SPRAYING ATOMS. Ore, A. (Univ. of Oslo). Fra Fys. Verden; 35: No. 2, 30-33(1973). (In Norwegian).

The phenomenon of the Auger effect and Auger cascades in combination with electron emission is discussed informally. Electron capture and internal conversion are mentioned as initiating such phenomena, but the most attention is given to x-ray excitation of the emitting atoms. "Charge spectra" are discussed with Xe 131 and mercury as examples. The discussion is confined to the excitation of free atoms, but the possible effects on atoms bound in molecules are mentioned. (JIW)

25709 ASYMPTOTIC EXPRESSION FOR THE K-SHELL IONIZATION CROSS SECTION WITH ELECTRONS. Kolbenstvedt, H. Ark. Fys. Seminar Trondheim; No. 10, 11p. (1973).

The total cross section for K-shell ionization with electrons is given as a function of the K-shell screening parameter θ for target elements with $Z \gtrsim 13$ and incident electron energies much higher than the K-shell binding energy. For an incident electron energy of 300 MeV, the cross section varies with the atomic number approximately as $Z^{-2.55}$ compared to the experimental result $Z^{-2.69}$. (auth)

25710 POTASSIUM AND TITANIUM KX-RAY DE-EXCITATION INDUCED BY ION BOMBARDMENT. Johnson, B.; Senglaub, M.; Richard, P.; Moore, C. F. (Univ. of Texas, Austin). Z. Phys.; 261: No. 5, 413-421(1973).

Kx-ray de-excitation spectra were produced for K and Ti by proton, alpha and oxygen ion beam bombardment. These spectra were measured with a crystal spectrometer of resolution (FWHM) of 10 and 13 eV for the $K\alpha_{1,2}$ line in K and Ti respectively. The additional lines not found in the normal x-ray spectra are attributed to multiple inner shell ionization. The energy shifts and relative intensities of these lines are compared to theoretical predictions. (GE)

25711 COMPUTED POTENTIAL HYPERSURFACE (INCLUDING ELECTRON CORRELATION) OF THE SYSTEM Li^+/H_2. Kutzelnigg, W.; Staemmler, V.; Hoheisel, C. (Univ., Karlsruhe, Ger.). Chem. Phys. (Amsterdam); 1: No. 1, 27-44(1973).

The potential hypersurface of the system LiH_2^+ is calculated in the Hartree–Fock approximation and with the IEPA PNO method (including electron correlation). The basis set consists of gaussian lobes. The region of H–H distances considered is 0.9 to 3 α_0 (occasionally to 5 α_0) whereas the distance of the Li nucleus to the midpoint of the H_2 subunit is varied between 1 and 15 α_0. The angular dependence of the hypersurface is investigated as well. The maximum overall error (except for a parallel shift of the whole hypersurface) is estimated to be less than 0.002 au and even smaller in more limited regions of space. The role of the correlation energy is discussed and the asymptotic behavior of the Li^+/H_2 interaction is compared with results from perturbation theory. The results are given both as tables of numbers and in the form of an analytic fit. The change of energy, equilibrium distance and force constant of the H_2 as a function of the approach of the Li^+ is also tabulated. (auth)

Atomic Theory

Refer also to abstracts 26029 and 26428.

25712 QUANTUM TREATMENT OF SPONTANEOUS EMISSION WITHOUT PHOTONS. Lama, W. L.; Mandel, L. (Univ. of Rochester, NY). pp 273-288 of Coherence and Quantum Optics. Mandel, L. (ed.). New York; Plenum Publishing Corp. (1973).

From 3rd Rochester conference on coherence and quantum optics; Rochester, NY (21 Jun 1972).

The question of whether it is possible to account for spontaneous emission of electromagnetic radiation from atoms without quantum electrodynamics is considered. It is shown that Nesbet's argument for accounting for exponential atomic decay is not consistent with quantum mechanics. In order to save the situation one is led to make several additional assumptions and a re-interpretation of the nature of the quantum system. (JFP)

25713 MULTIPERTURBATION THEORY OF ELECTRON CORRELATION IN ATOMS. Sanders, F. C. (Department of Physics and Astronomy, Southern Illinois University—Carbondale, Carbondale, Illinois 62901). Phys. Rev. A 7: No. 6, 1870-1875 (June 1973).

A multiperturbation theory for atomic systems is developed. The theory automatically decouples Rayleigh–Schrödinger perturbation theory into multiperturbation partial differential equations for the 2-(n + 1)-electron components of the n^{th}-order wave function. Variational–perturbation equations for these multiperturbation wave functions are derived together with expressions for the multiperturbation energy-expansion coefficients. The "bare-nucleus" hydrogenic function is chosen as the zero-order wave function rather than the more customary Hartree–Fock function. With this choice the multiperturbation wave functions are independent of the nuclear charge and of the total number of electrons in the system, and are thus completely transferable to other systems. The "cluster-expansion" wave function is analyzed in terms of the multiperturbation wave functions, and the connection between cluster-type expansions and ordinary perturbation theory is shown in detail. (auth)

PHYSICS (ELECTROFLUID AND MAGNETOFLUID)

25714 HEAT TRANSFER IN MAGNETOHYDRODYNAMIC LAMINAR SOURCE FLOW BETWEEN TWO PARALLEL DISKS. Khader, M. S. Auburn, AL; Auburn Univ. (1973). 132p. University Microfilms Order No. 73-21,760.

Thesis (Ph. D.).

The steady axisymmetrical laminar source flow of an incompressible electrically conducting fluid between two circular parallel disks in the presence of a transverse applied magnetic field is analyzed. A solution for the equations of motion is obtained by expanding the velocity and the pressure distributions in terms of power series of the reciprocal of the radial coordinate. Velocity and induced magnetic fields and pressure and shear stress distributions are determined. The energy equation is then solved numerically for the temperature distribution, where both Joulean and viscous heating are included. It is found that the applied magnetic field influences both the hydrodynamic and thermal fields. Both local and average Nusselt numbers for the case of constant wall temperature are evaluated. For fluids of moderate and high Prandtl numbers, the Nusselt number is seen to be a strong function of both Hartmann number and a heat generation parameter together with a modified Peclet number. However, for fluids of small Prandtl number, Joulean heating and viscous dissipation can be neglected without appreciable error. (Diss. Abstr. Int., B.)

25715 MAGNETODINAMICA FLUIDELOR. (Magneto-Fluid Dynamics). Dragos, L. Bucharest; Editura Academiei Republicii Socialiste Romania (1969). 476p. (In Rumanian).

Electromagnetic field theory (starting from the microscopic theory) is introduced with special application to continuous media in motion. Continuum regimes (such as fluids) constitute the central theme while no attempt is made to cover magnetoplasma effects. The general constitutive equation are derived. Conditions for subsequent approximations are presented. The basic equations of fluid motion, electrodynamics, thermodynamics of conducting fluid are brought together with boundary conditions, in both integral and differential form. The basic laminar solutions for plane or axisymmetric MHD flows are presented while a major application of such flows, namely, MHD generators, is dealt with. Hall effects and the influence of the induced magnetic field are discussed. Next MHD flow past thin airfoils or bodies is covered. Incompressible and compressible flows are treated for both perfectly conducting and electrically resisting fluids. General considerations of the linearized theory are given. The viscous MHD flow past thin bodies at various angles of incidence is discussed. Discontinuities in MHD flows are studied. The general theory of quasi-linear partial differential equations is applied to study propagation of small disturbances in conducting fluids. Flows through simple waves are also included. The theory of shock waves (strong discontinuities) including their stability is covered. An appendix on Cartesian vectors and tensors concludes the book. (MHR)

PHYSICS (HIGH-ENERGY)

Particle Interactions and Properties (Experimental)

25716 (UCRL-Trans-1496) EVIDENCE FOR THE POSSIBLE EXISTENCE OF A CHARGED PARTICLE WITH LARGE MASS. Translated from Wu-Li; 1: No. 2, 57-62(1972). 9p. Dep. NTIS $3.00.

On a high mountain at an altitude of 3200 meters, a superhigh-energy event was obtained utilizing a large magnetic cloud chamber. Three tracks were observed. From the initial measurement and analysis results, one particle of the event was interpreted as a pion and another as a proton or ordinary hadron. It is suggested that the third particle is no known particle and may be a charged particle with a mass greater than 10 GeV/c^2. (LBS)

25717 COHERENT LIGHT EMISSION BY ATOMS EXCITED BY FAST PARTICLES IN AN ELECTROMAGNETIC FIELD. Ryazanov, M. I. (Moscow Engineering-Physics Inst.). Zh. Eksp. Teor. Fiz.; 65: No. 1, 123-131(Jul 1973). (In Russian).

It is shown that the directions of the coherent light emission in a system of atoms excited by fast particles appear due to the electromagnetic wave field. The direction of the coherent waves is rigidly related to the frequency of the radiation, velocity of the particle and characteristics of the electromagnetic wave. Resonance between the wave frequency and frequency of transition between two atomic excited states is investigated. The possibility of employing coherent emission for measuring the energy of fast particles is discussed. (auth)

Electromagnetic

Refer also to abstracts 24386 and 25803.

25718 (JINR-P3-7149) ELEMENTARY THEORY FOR THE METHOD OF DETERMINATION OF THE ELECTRICAL DIPOLE NEUTRON MOMENT USING UCN. 2. "Storage" Variant. Taran, Yu. V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1973. 20p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

An elementary theory is given for the "storage" variant of the spectrometer of the electrical dipole moment (EDM) using ultracold neutrons (UCN). The sensitivities of the EDM spectrometers of the "pass" type and of the "storage" type are compared. The advantages of the second type are revealed. The theoretical conclusions are checked by means of numerical calculations using a spectrometer of concrete construction. Good agreement of both the approaches is observed. (auth)

25719 (KFK-1822) TOTAL ABSORPTION CROSS SECTION OF VIRTUAL PHOTONS WITH MASSES 0.1 (GeV/c)$^2 \leq q^2 \leq$ 1.5 (GeV/c)^2 ON PROTONS AND DEUTERONS IN THE RESONANCE REGION. Koebberling, M.; Moritz, J.; Schmidt, K. H.; Wegener, D.; Zeller, D.; Bleckwenn, J.; Heimlich, F. H. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Experimentelle Kernphysik). Jun 1973. 46p. Dep. NTIS (U. S. Sales Only) $4.50.

The two-fold differential cross section for inelastic electron-proton, electron-deuteron, and electron-neutron scattering in the resonance region ($W \leq 1.90$ GeV) for four-momentum transfers 0.1 (GeV/c)$^2 \leq q^2 \leq$ 1.5 (GeV/c)^2 is tabulated. The sources of error are discussed. (GE)

25720 (KHFTI-72-22) CONCERNING THE POSSIBILITY OF STUDYING THE REACTION $^4He(\gamma,\pi^0)^4He$ WITH THE AID OF A DIFFUSION CHAMBER BY THE DIFFERENCE METHOD. Arkatov, Yu. M.; Vatset, P. I.; Voloshchuk, V. I.; Kirichenko, V. V.; Khodyachikh, A. F. (Akademiya nauk Ukrainskoi SSR, Kharkov. Fiziko-Tekhnicheskii Institut). 1972. 16p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

The possibility of studying the reaction of the elastic photoproduction of π^0 mesons on ^{4}He by use of a diffusion chamber with the difference method was examined. Preliminary data were reported. (tr-auth)

25721 TOTAL CROSS SECTION FOR π^+ ELECTROPRODUCTION ON HYDROGEN NEAR THRESHOLD. Botterill, D. R. (Daresbury Nuclear Physics Lab., Eng.); Braben, D. W.; Kikuchi, R.; Norton, P. R.; Del Guerra, A.; Giazotto, A.; Giorgi, M. A.; Steffanini, A. Phys. Lett.; 45B: No. 4, 405-408(6 Aug 1973).

The total cross section for the reaction ep $\rightarrow$ enπ^+ at momentum transfer $|k^2|$ between 0.08 and 0.32 (GeV/c)^2 and for center of mass energies between threshold, at W = 1.078 GeV, and W = 1.106 GeV was measured by detecting the electron and neutron in coincidence. Comparisons are made with both current algebra and dispersion relation theoretical models. (auth)

25722 MEASUREMENT OF THE AZIMUTHAL ANGLE DEPENDENCE OF THE PROCESS ep $\rightarrow$ enπ^+ NEAR THRESHOLD. Del Guerra, A. (Univ., Pisa, Italy); Giazotto, A.; Giorgi, M. A.; Stefanini, A.; Botterill, D. R.; Braben, D. W.; Norton, P. R. Phys. Lett.; 45B: No. 4, 409-410(6 Aug 1973).

The azimuthal angle dependence of the process ep $\rightarrow$ enπ^+ has been measured by detecting the electron and neutron in coincidence. Data are presented for momentum transfers ($-k^2$) between 0.08 and 0.32 (GeV/c)^2 and at energies close to threshold. Fixed-t dispersion relation models give predictions in good qualitative agreement with the data. (auth)

25723 π^+-ELECTROPRODUCTION ON HYDROGEN NEAR THRESHOLD AT FOUR-MOMENTUM TRANSFERS OF 0.2, 0.4 AND 0.6 GeV^2. Brauel, P.; Buesser, F. W.; Canzler, T.; Cords, D.; Dix, W. R.; Felst, R.; Grindhammer, G.; Kollmann, W. D.; Krehbiel, H.; Meyer, J.; Weber, G. (DESY, Hamburg). Phys. Lett.; 45B: No. 4, 389-393(6 Aug 1973).

The reaction e + p $\rightarrow$ e' + π^+ + n was measured near the one pion threshold, detecting the final electron and neutron in coincidence for values of q^2 = 0.2, 0.4 and 0.6 GeV^2. The normalized axial vector form factor of the nucleon $F_A(q^2)/F_A(0)$ was determined from the data within a theoretical framework based on PCAC and current algebra. (auth)

25724 MEASUREMENT OF THE ELECTROMAGNETIC-TRANSITION FORM FACTOR FOR THE $S_{11}(1535)$ RESONANCE. Kummer, P. S.; Ashburner, E.; Foster, F.; Hughes, G.; Siddle, R. (University of Lancaster, Lancaster, England); (and others). Phys. Rev. Lett. 30: No. 18, 873-876 (30 Apr 1973).

We have measured the cross section for the process $e+p\rightarrow e'+p+\eta^0$ near threshold for values of the four-momentum transfer between 0.15 and 1.5 (GeV/c)^2. Assuming that the cross section is dominated by production of the $S_{11}(1535)$ resonance, we have compared our data with quark-model calculations which predict the transition matrix elements for the reaction $e+p\rightarrow e'+S_{11}(1535)$. (auth)

25725 GENERATION OF INTENSE INFRARED RADIATION FROM AN ELECTRON BEAM PROPAGATING THROUGH A RIPPLED MAGNETIC FIELD. Friedman, M.; Herndon, M. (Plasma Physics Division, Naval Research Laboratory, Washington, D.C., 20390). Appl. Phys. Lett. 22: No. 12, 658-660 (15 June 1973).

Electromagnetic radiation in the far-infrared region of the spectrum was produced by the interaction between a relativistic electron beam and a spatially modulated magnetic field. Power of the order of megawatts was observed at wavelengths greater than about 50 μ. The radiation does not originate from a simple synchrotron mechanism, and one has to invoke other processes. (auth)

25726 MUON-NUCLEON INELASTIC INTERACTIONS AT HIGH ENERGY. Jain, P. L.; Malucci, R. D.; Potoczak, M. J.; Wixon, N. J. (High Energy Experimental Laboratory, Department of Physics, State University of New York at Buffalo, Buffalo, New York 14214). Phys. Rev. D 7: No. 11, 3248-3264 (1 June 1973).

The inelastic interactions of 10.1-GeV/c positive and 15.8-GeV/c negative muons produced at the Brookhaven alternating gradient synchrotron have been studied in nuclear emulsions. Secondary particles produced in these interactions have been identified; their energy spectrum and angular distribution (in the c.m. system) are given for pions, kaons, and protons along with their partial cross sections. The inclusive pion-production reaction is studied and the relative shapes of the p_t^2 (transverse momentum)^2 and p_l (longitudinal momentum) distributions are discussed and compared with γp, πp, and pp reactions. The partial and integral cross sections have been measured for both beams along with the energy dependence of their total cross sections and are compared with theory by using the first, second, and fourth power of $1/1(1 + q^2/m_p^2)$ for $\sigma_{exp}(q^2,\nu)$, the quantity commonly called the "virtual-photon-nucleon total cross section." The values of the structural function νW_2 are calculated for $0.025 \leq q^2 \leq 0.3$(GeV/c)^2 and large values of $\omega' \geq 10$. The present data are compared with the previous muon data of Perl at low q^2 values and various theoretical models are considered to test scaling at low q^2 values. (auth)

25727 IMPROVED UPPER LIMIT FOR THE ELECTRIC DIPOLE MOMENT OF THE NEUTRON. Dress, W. B.; Miller, P. D. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830); Ramsey, N. F. Phys. Rev. D 7: No. 11, 3147-3149 (1 June 1973).

The previously described neutron resonance spectromenter has been modified to improve the determination of the effect of $\vec{E}\times\vec{v}/c$. An improved upper limit has been obtained for the neutron electric dipole moment of $|\mu_e/e| < 1.0\times10^{-23}$ cm with 80% confidence. (auth)

25728 VECTOR-MESON PRODUCTION BY POLARIZED PHOTONS AT 2.8, 4.7, AND 9.3 GEV. Ballam, J.; Chadwick, G. B.; Eisenberg, Y.; Kogan, E.; Moffeit, K. C.; (and others) (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). Phys. Rev. D 7: No. 11, 3150-3177 (1 June 1973).

We present results on vector-meson photoproduction via $\gamma p \rightarrow Vp$ in the LBL-SLAC 82"-in. hydrogen bubble chamber exposed to a linearly polarized photon beam at 2.8, 4.7, and 9.3 GeV. We find ρ^o production to have the characteristics of a diffractive process, i.e., a cross section decreasing slowly with energy and a differential cross section with slope of $\sim$6.5 GeV^{-2}. Within errors the ρ^o production amplitudes are entirely due to natural-parity exchange. S-channel helicity is conserved to a high degree in the $\gamma \rightarrow \rho^o$ transition. We find evidence for small helicity-flip amplitudes for $\pi\pi$ pairs in the ρ^o region. Photoproduction of ω mesons is separated into its natural- (σ^N) and unnatural-(σ^U) parity-exchange contributions. The E_γ and t dependence and the spin density matrix of the unnatural-parity-exchange contribution are consistent with a one-pion-exchange process. The natural-parity-exhange part has characteristics similar to ρ^o production. At 9.3 GeV the ratio of σ (ρ^o) to $\sigma^N(\omega)$ is $\sim$7. The slope of the ϕ differential cross section is $\sim$4.5 GeV^{-2}, smaller than that of ρ^o and ω production. Natural-parity exchange is the main contributor to ϕ production. No evidence for higher-mass vector mesons is found in $\pi\pi$, $\pi\pi\pi$, or $K\bar{K}$ final states. The s and t dependences of Compton scattering as calculated from ρ, ω, and ϕ photoproduction using vector-meson-dominance agree with experiment, but the predicted Compton cross section is too small by a factor of 2. (auth)

25729 MEASUREMENT OF THE Σ^+ MAGNETIC MOMENT. Saha, M.; Fetkovich, J. G.; Heintzelman, W.; Meltzer, C.; Murphy, C. T. (Department of Physics, Carnegie-Mellon University, Pittsburgh, Pennsylvania 15213). Phys. Rev. D 7: No. 11, 3295-3302 (1 June 1973).

Approximately 370000 pictures of slow K^- interactions were taken in the Michigan-Argonne propane bubble chamber at the Argonne National Laboratory Zero-Gradient Synchrotron. They were scanned for the reaction $K^-p \rightarrow \Sigma^+\pi^-$ produced by K^- in the momentum range 250-550 MeV/c. A 45-kG magnetic field applied perpendicular to the incident beam precessed the spin of the Σ^+ through an average angle of 9 °. The final sample, after cuts, consisted of 2651 events with an average time of flight of 1.5×10^{-10} sec and an average polarization of 0.37. A maximum-likelihood analysis yielded 2.7 ± 0.9 nuclear magnetons for the Σ^+ magnetic moment. (auth)

25730 RECENT RESULTS ON INCLUSIVE ELECTRON SCATTERING FROM HYDROGEN, DEUTERIUM, AND OTHER NUCLEI. Bloom, E. D. (California Inst. of Tech., Pasadena). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 12, 277-295(1973).

From conference on high energy particle interactions; Nashville, TN (26 Mar 1973).

Recent and new results are discussed on inelastic electron scattering. The data from H, D cover angles from 4° to 34°, also data from Be, Al, Cu, Au taken at 4° are shown. (auth)

25731 HADRONIC FINAL STATES FROM INELASTIC MUON SCATTERING IN A HYBRID BUBBLE CHAMBER EXPERIMENT. Negra, M. D. (Stanford Univ., CA). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 12, 296-308(1973).

From conference on high energy particle interactions; Nashville, TN (26 Mar 1973).

A study of general features of charged hadron production by inelastically scattered 16 GeV muons detected in the SLAC rapid cycling 40" hydrogen bubble chamber is presented. (auth)

25732 RECENT RESULTS IN COINCIDENCE ELECTROPRODUCTION IN THE DEEP INELASTIC REGION. Hartill, D. L. (Cornell Univ.; No. 12, 309-321(1973).

From conference on high energy particle interactions; Nashville, TN (26 Mar 1973).

Data are presented on the electroproduction reactions $e + p \rightarrow e + p + X^0$, $e + p \rightarrow e + \pi^+ + X^0$, and $e + p \rightarrow e + \pi^- + X^{++}$ in the deep inelastic region. The kinematic region covered was $0.4 \leq Q^2 \leq 2.2$ (GeV/c)^2, $2.5 \leq \nu \leq 7.0$ GeV and $4 \leq s = W^2 \leq 16$ (GeV)^2 where Q^2 = electron momentum transfer, ν = lab energy loss of the electron and $s = W^2$ = invariant (mass)^2 of the hadronic final state. (auth)

25733 HADRONIC FINAL STATES IN ELECTROPRODUCTION. Bebek, C. (Harvard Univ., Cambridge, MA); Brown, C. N.; Herzlinger, M.; Holmes, S.; Lichtenstein, C. A.; Pipkin, F. M.; Sisterson, L. K.; Andrews, D.; Berkelman, K.; Cassel, D. G.; Hartill, D. L. AIP (Amer. Inst. Phys.) Conf. Proc.; No. 12, 322-345(1973).

From conference on high energy particle interactions; Nashville, TN (26 Mar 1973).

Data are presented on electroproduction off protons in which a hadron moving in approximately the same direction as the virtual photon is detected. Measurements were made at data points with nominal (Q^2,W) values of (0.6, 2.68), (1.2, 2.68), (2.0, 2.68), and (1.2, 2.15) in (GeV^2, GeV). The virtual photoproduction cross sections for ($\pi^\pm$, k^+, p) + Missing Mass are studied as a function of missing mass, Feynman scaling variables, Q^2 and W. The results suggest a simple scaling behavior for pions. The data for the channel π^+n are used to determine values for the pion form factor. Protons show a simple behavior as a function of Q^2 but not W. The K^+ data show that the $K^+\Sigma^0$ cross section falls more rapidly than the $K^+\Lambda$ cross section as Q^2 increases. There is evidence for hyperon resonance production in the missing mass distributions. (auth)

25734 DEEP INELASTIC ELECTROPRODUCTION: THE PHOTON FRAGMENTATION REGION. Dakin, J. (Stanford Univ., CA). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 12, 346-355(1973).

From conference on high energy particle interactions; Nashville, TN (26 Mar 1973).

Data are presented on the electroproduction of hadrons. The virtual photons are in the kinematic range $-0.25 > q^2 > -3.00$ (GeV/c)^2, $6 < W^2 < 30$ GeV^2. Hadrons produced with large laboratory momentum in the direction of the virtual photons are observed. The fraction of elastic ρ^0 mesons with longitudinal polarization is too large to support a vector dominance model for deep inelastic electron scattering. An excess of positive relative to negative hadrons is observed both with proton and with neutron targets. Other electroproduction experiments are reviewed. It is noted that as scaling turns on between $q^2 = 0$ and $q^2 = -1$ GeV^2 the electroproduced hadrons assume a less diffractive character consistent with the quark parton model. (auth)

Weak

25735 NEW MEASUREMENT OF THE $K_L^0 \rightarrow \pi^+\pi^-$ BRANCHING RATIO. Messner, R.; Morse, R.; Nauenberg, U. (Duane Physical Laboratories, University of Colorado, Boulder, Colorado, 80302); Hitlin, D.; Liu, J.; (and others). Phys. Rev. Lett. 30: No. 18, 876-879 (30 Apr 1973).

We have measured the ratio $\Gamma(K_L^0 \rightarrow \pi^+\pi^-)/\Gamma(K_L^0$ –all charged) to be $(2.64\pm0.09)\times10^{-3}$ a value significantly higher than the current accepted world average of $(2.00\pm0.07)\times10^{-3}$. This ratio, together with currently accepted values for the K_S^0–2π branching ratio and K_{LS}^0 lifetimes, yields a value of $|\eta_{+-}| = (2.23\pm0.05)\times10^{-3}$. (auth)

25736 MUON POLARIZATION IN THE DECAY $K_L^0 \rightarrow \pi^-\mu^+\nu_\mu$, AN EXPERIMENT TEST OF TIME-REVERSAL INVARIANCE. Sandweiss, J.; Sunderland, J.; Turner, W.; Willis, W. (Yale University, New Haven, Connecticut, 06520); Keller, L. Phys. Rev. Lett. 30: No. 20, 1002-1006 (14 May 1973).

We report the results of a high-statistics scintillation-counter electronics experiment measuring the muon polarization in the decay $K_L^0 \rightarrow \pi^-\mu^+\nu_\mu$ by the method of spin precession. We present results for the real and the imaginary parts of the form-factor ratio. (auth)

25737 SEARCH FOR THE REACTION $K^+ \rightarrow \pi^+ + \nu\bar{\nu}$. Cable, G. D. Tucson, AZ; Univ. of Arizona (1973). 107p. University Microfilms Order No. 73-20,673.

Thesis (Ph. D.).

In a counter experiment at the Lawrence Berkeley Laboratory Bevatron a search was made for the process $K^+ \rightarrow \pi^+\nu\bar{\nu}$ in the kinetic energy interval $60 < T_\pi < 105$ MeV and no examples of this decay mode were found. Combining the data with those of Klems, Hildebrand, and Stiening for the interval $117 < T_\pi < 127$ MeV, the limit $\Gamma(K^+ \rightarrow \pi^+\nu\bar{\nu}) < 5.6\times10^{-7}\,\Gamma(K^+ \rightarrow$ all) was found, assuming a (vector) spectrum like that for $K^+ \rightarrow \pi^0e^+\nu$. Limits are presented for other assumed spectra. (auth)

25738 DETERMINATION OF THE MEAN LIVES OF THE CASCADE HYPERONS. Sanders, A. J. Boston; Tufts Univ. (1973). 176p. University Microfilms Order No. 73-19,760.

Thesis (Ph. D.).

From a final sample of 123 Ξ^0 events and 335 Ξ^- events detected in a heavy liquid bubble chamber the mean lives of the cascade hyperons were determined as $\tau_{\Xi^0} = (3.01^{+0.53}_{-0.41})\times10^{-10}$ sec, and $\tau_{\Xi^-} = (1.79^{+0.19}_{-0.17})\times10^{-10}$ sec. These are consistent with the results of hydrogen bubble chamber experiments. The α decay parameters were determined from slightly different final samples as $\alpha_{\Xi^0} = -0.84 \pm 0.27$ and $\alpha_{\Xi^-} = -0.42 \pm 0.11$, which are consistent with previous determinations. Both the lifetime and the α measurements are consistent with the $\Delta I = \frac{1}{2}$ rule. (auth)

25739 MEASUREMENT OF THE K_S CONTENT OF THE K^0 STATE AND THE BRANCHING RATIO BETWEEN THE $K_S\,2\pi$

DECAYS. Sager, D. J. Princeton, NJ; Princeton Univ. (1972). 146p. University Microfilms Order No. 73-18,779.

Thesis (Ph. D.).

The K^0 meson state is a superposition of the short-lived and long-lived states, K_S and K_L. The K_S component decays principally to charged or neutral pion pairs. By observing the production of an ensemble of K^{0*}s and the decay of the K_S's we determined: (1) the proportion of K_S in the K^0 state, and (2) the branching ratio between the charged and neutral two-pion decay modes of the K_S. $R(K_S \rightarrow \pi^+\pi^-)/R(K_S \rightarrow \pi^0\pi^0) = 2.22 + 0.08$ was found. Within the framework of a phenomenological theory, the amount of K_S overlap with the K^0 state is a test of CPT invariance of the weak Hamiltonian. The results, in excellent agreement with CPT invariance, yield for the usual CPT violating parameter Re $\delta = -0.0014 \pm 0.0075$. (auth)

Strong (Baryon-induced)

Refer also to abstract 26102.

25740 (EFI-KL-9(72)) ANALYSIS OF THE THEORETICAL AND EXPERIMENTAL DATA ON THE MULTIPLICITY OF SECONDARY PARTICLES FOR NUCLEON–NUCLEON AND PION–NUCLEON INTERACTIONS OF HIGH ENERGIES. Avakian, V. V.; Keropian, M. I.; Mamidyanian, E. A. (Akademiya Nauk Armyanskoi SSR, Erevan. Institut Fiziki). 1972. 12p. INIS.

The collection of world experimental data on the multiplicity $\langle n_s \rangle$ of the secondary charge particles of nucleon–nucleon and pion–nucleon interactions is given in the $5-5 \cdot 10^4$ Bev energy region. All theoretical models, which predict the dependence of $\langle n_s \rangle$ as a function of primary energy E_0 are analysed. The semi-spherical formula, which properly describes all correct experimental data on $\langle n_s \rangle$ for nucleon–nucleon interactions is obtained for $10^1 - 10^4$ Bev energy region. Accordingly our energy region, $\langle n_s \rangle = (4.09 \pm 0.008) + (0.13 - 0.006)\ E_0^{\frac{1}{4}}$. (auth)

25741 MULTIPLICITY DISTRIBUTION OF SHOWER PARTICLES UNDERGROUND AND THE COSMIC-RAY PRIMARY SPECTRUM. Bergamasco, L. (CNR, Turin); Castagnoli, C.; D'Ettorre Piazzoli, B.; Sitte, K.; Picchi, P.; Visentin, R. Lett. Nuovo Cim.; 8: No. 1, 1-5(1 Sep 1973).

An attempt is made to show that neither the composition of the primary cosmic radiation nor the characteristics of hadronic interactions undergo drastic changes in the energy range above some 10^{15} eV. Particle multiplicities shown as a function of the average shower size and the observed frequencies are given. It is found that the change in slope of the shower size distribution is that of a genuine steepening of the primary energy spectrum above a few 10^{15} eV. (JFP)

25742 REACTIONS $d + p \rightarrow \tau + \pi^0$ AND $d + p \rightarrow \tau + \eta^0$. Banaigs, J. (CEN, Saclay, France); Berger, J.; Goldzahl, L.; Risser, T.; Vu-Hai, L.; Cottereau, M.; Le Brun, C. Phys. Lett.; 45B: No. 4, 394-298(6 Aug 1973).

The reactions $d + p \rightarrow \tau + \pi^0$ and $d + p \rightarrow \tau + \eta^0$ were studied using the missing-mass method for incident deuteron momenta between 2.8 and 3.8 GeV/c. The angular distributions show a peak in the forward direction ($\theta_\tau^* = 0^0$) and are flat in the backward direction. The differential cross sections at $\theta_\tau^* = 180°$ for both reactions show a maximum for total center-of-mass energies near 3.46 GeV. (auth)

25743 pp INTERACTIONS AT 303 GeV/c: ANALYSIS OF DIFFRACTION EXCITATION IN THE REACTION $pp \rightarrow pX$. Dao, F. T. (National Accelerator Lab., Batavia, IL); Gordon, D.; Lach, J.; Malamud, E.; Schivell, J.; Meyer, T.; Poster, R.; Schlein, P. E.; Slater, W. E. Phys. Lett.; 45B: No. 4, 399-401(6 Aug 1973).

The properties of the diffractively excited system observed at low missing mass in the inclusive $pp \rightarrow pX$ reaction at 303 GeV/c are presented. For diffraction excitation with $|x| > 0.9$, the cross section, $\sigma_D = (5.6 \pm 0.8)$ mb, the mean charged multiplicity depends on the mass of the diffractive system approximately at $\langle n_c \rangle \approx 0.6M_X + 2$, and the slope of the momentum transfer distribution with $|t| < 0.5$ GeV^2 is 7.5 ± 0.8 GeV^{-2}. (auth)

25744 pp INTERACTIONS AT 303 GeV/c: SEPARATION OF DIFFRACTIVE AND NONDIFFRACTIVE COMPONENTS OF THE MULTIPLICITY DISTRIBUTION. Dao, F. T. (National Accelerator Lab., Batavia, IL); Gordon, D.; Lach, J.; Malamud, E.; Schivell, J.; Meyer, T.; Poster, R.; Schlein, P. E.; Slater, W. E. Phys. Lett.; 45B: No. 4, 402-404(6 Aug 1973).

The properties of the inclusive $pp \rightarrow pX$ reaction at 303 GeV/c were studied. Protons of momentum 1.4 GeV/c of less are measured and identified by their ionization. The multiplicity distribution associated with those events having a small four-momentum transfer to the target proton is investigated. Under the assumption that this selection enhances or isolates the diffractive component of the interaction, the properties of the diffractive and nondiffractive components are discussed. (auth)

25745 NEUTRAL-STRANGE-PARTICLE PRODUCTION IN 205-GEV PP INTERACTIONS. Charlton, G.; Cho, Y.; Colley, D.; Derrick, M.; Engelmann, R.; (and others) (Argonne National Laboratory, Argonne, Illinois 60439). Phys. Rev. Lett. 30: No. 12, 574-577 (19 Mar 1973).

A bubble-chamber study of proton–proton interactions at 205 GeV yielded 66K^0s, 28 Λ's, and 2 $\bar{\Lambda}$'s produced in the backward c.m. hemisphere. The cross sections for $p+p \rightarrow (\Lambda/\Sigma^0)$+anything and $p+p \rightarrow (K^0/\bar{K}^0)$ +anything are 3.2±0.6 and 12.9±1.7 mb, respectively. Comparison of the invariant cross section with lower-energy data shows that (Λ/Σ^0) production is consistent with approximate scaling behavior above 28 GeV, whereas the $(K^0/\bar{K}^0)$ invariant cross section has increased considerably between 28 and 205 GeV. (auth)

25746 TWO-PARTICLE CORRELATION IN THE $\bar{p}p \rightarrow 3\pi^+3\pi^-\pi^0$ REACTION AT 5.7 GEV/C. Braun, H.; Fridman, A.; Gerber, J. P.; Givernaud, A.; Juillot, P.; (and others) (Laboratoire de Physique Corpusculaire Centre de Recherches Nucléaires de Strasbourg – Strasbourg, France). Phys. Rev. D 7: No. 11, 3243-3248 (1 June 1973).

A study of the two-particle correlation in the $\bar{p}p \rightarrow 3\pi^+3\pi^-\pi^0$ reaction has been carried out, using the variables utilized for describing inclusive processes. Correlation functions expressed in terms of one variable were defined and used for the $\bar{p}p \rightarrow 3\pi^+3\pi^-\pi^0$ channel. A procedure has been proposed which allows one to eliminate events for which the constraints due to the kinematical boundaries yield to negative values of the correlation functions. The fourth-differential transverse-momentum distribution for a pair of outgoing charged pions, $d^4N/(d\vec{p}_{T1}d\vec{p}_{T2})$, was described by a simple parametrization, allowing a direct measurement of the correlation between transverse momenta. (auth)

25747 ANALYSIS OF TWO-PRONG EVENTS IN PROTON-PROTON INTERACTIONS AT 6.6 GEV/C. Colton, E. (Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720); Ming Ma, Z.; Smith, G. A.; Schlein, P. E. Phys. Rev. D 7: No. 11, 3267-3295 (1 June 1973).

A detailed analysis is presented of the reactions $pp \rightarrow pp$, $pp \rightarrow pp\pi^0$, and $pp \rightarrow p\pi^+n$. The production cross sections are found to be 11.47 ± 0.33 mb, 2.54 ± 0.16 mb, and 5.73 ± 0.35 mb, respectively. The t dependence of elastic scattering can be described by the form $e^{7.9t}$ over the range $0.05 < -t < 0.50$ GeV^2. The single-particle distributions for the single-pion production processes are presented. Further detailed analyses are presented which demonstrate that pion-exchange phenomenology, both elementary and Reggeized, can account for the gross features of the peripheral $pp \pm p\pi^+n$ data for $M(p\pi^+) < 2.4$ GeV. Isospin-(1/2) isobars are produced by some other processes in the channel $pp \rightarrow pN^{*+}$, especially when the invariant mass of the pion with the unrelated proton is large. We discuss the properties of these isobars. (auth)

25748 $\pi-\pi$ SCATTERING, 1973. International Conference on $\pi-\pi$ Scattering and Associated Topics, Tallahassee, Florida, March 28–30, 1973. Williams, P. K.; Hagopian, V. (eds.). AIP Conference Proceedings, Number 13. Particles and Fields Subseries No. 5. New York; American Institute of Physics (1973). 372p.

Thirty-one papers are included; separate abstracts are prepared for thirty. One paper was previously abstracted for NSA and appeared as 28: 11656. (LBS)

For abstracts of individual papers see: 25791–25798, 25923–25939, 25968–25971, and 25989.

25749 HIGH ENERGY COHERENT INTERACTION OF DEUTERONS ON PROTONS. Banaigs, J. (CEN, Saclay, France); Berger, J.; Goldzahl, L.; Vu Hai, L.; Cottereau, M.; le Brun, C.; Fabbri, F. L.; Picozza, P. Phys. Lett.; 45B: No. 5, 535-539 (20 Aug 1973).

The reaction $dp \rightarrow d + (mm)$ was performed with the aim of studying coherent interactions. The produced missing mass (mm) is in a pure isospin state $T = \frac{1}{2}$. A significant inelastic coherent production was observed at small transfer, decreasing with momentum transfer in a fashion similar to elastic scattering. (auth)

25750 PHOTON PRODUCTION IN 69 GeV pp INTERACTIONS. Collaboration France-Soviet Union. Phys. Lett.; 45B: No. 5, 525-527(20 Aug 1973).

Results are presented on 728 photon conversions into electron pairs observed in the hydrogen bubble chamber MIRABELLE. The average number of π^0 per inelastic pp collision is found to be 2.57 ± 0.13 and this number increases with the number n of charged particles up to n = 12. The comparison of our invariant cross section $F(x,p_\perp,s)$ for the reaction $pp \rightarrow \gamma X$ with higher energy results shows that scaling behavior is probably reached at 70 GeV. (auth)

25751 INCLUSIVE NEUTRAL KAON AND LAMBDA PRODUCTION IN 69 GeV pp INTERACTIONS. Collaboration France-Soviet Union. Phys. Lett.; 45B: No. 5, 528-530(20 Aug 1973).

From a study of 180 neutral vees in the hydrogen bubble chamber Mirabell, 8.4 ± 1.1 and 3.6 ± 0.5 mb were obtained respectively for the cross sections of the inclusive reactions $pp \rightarrow K^0X$ and $pp \rightarrow \Lambda X$. Data presented for the neutral kaons and Λ in terms of the invariant cross section $F(x,p_\perp,s)$ show, when compared with lower and higher energy results, that scaling is approximately valid at our energy for K^0 and Λ production. (auth)

25752 EXPERIMENTS ON HIGH ENERGY PARTICLE COLLISIONS, 1973. Proceedings of the International Conference Held at Nashville, Tennessee, March 26–28, 1973. Panvini, R. S. (ed.). AIP Conference Proceedings, Number 12. Particles and Fields Subseries No. 4. New York; American Institute of Physics (1973). 445p.

Twenty-eight papers are included; a separate abstract was prepared for each paper. (LBS)

For abstracts of individual papers see: 25730–25734, 25753–25767, 25787, 25788, 25813, 25907, 25990, 26180, 26181, and 26213.

25753 PROTON–PROTON COLLISIONS AT 102 GeV/c. Slattery, P. (Univ. of Rochester, NY). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 12, 1-13(1973).

From conference on high energy particle interactions; Nashville, TN (26 Mar 1973).

Preliminary results from an analysis of 102-GeV/c proton-proton collisions using the NAL 30 inch bubble chamber are discussed. Single particle inclusive spectra for the reactions $pp \rightarrow p + \ldots$ and $pp \rightarrow \pi^\pm + \ldots$ are presented, and comparisons are made with corresponding data from other high energy experiments carried out both using NAL and lower energy accelerators. (auth)

25754 pp INTERACTIONS AT 205 GeV/c. Whitmore, J. (National Accelerator Lab., Batavia, IL). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 12, 14-35(1973).

From conference on high energy particle interactions; Nashville, TN (26 Mar 1973).

Preliminary results are presented on 205 GeV/c pp interactions in the 30-inch hydrogen bubble chamber. The single particle inclusive distributions are compared to other NAL data, ISR data, and data from lower energies. Data on charged particle correlations and the preliminary results of a study of the diffractive process are also discussed. (auth)

25755 pp INTERACTIONS AT 303 GeV/c: INCLUSIVE STUDIES OF γ, K^0_S, Λ^0, $\pi^\pm$ AND PROTON PRODUCTION. Dao, F. R. (National Accelerator Lab., Batavia, IL); Gordon, D.; Lach, J.; Malamud, E.; Schivell, J.; Meyer, T.; Poster, R.; Schlein, P. E.; Slater, W. E. AIP (Amer. Inst. Phys.) Conf. Proc.; No. 12, 36-59(1973).

From conference on high energy particle interactions; Nashville, TN (26 Mar 1973).

In an exposure of the 30 inch hydrogen bubble chamber to a 303 GeV/c proton beam, both V° events and all tracks with momentum less than 1.4 GeV/c were measured. From these measurements the properties and cross sections of the inclusive $pp \rightarrow \gamma X$, $K^0_S X$ and $\Lambda^0 X$ reactions are studied. In addition, single particle invariant cross sections for pions and protons are presented and the scaling behavior of these reactions is discussed. (auth)

25756 PHOTON, NEUTRAL KAON, AND LAMBDA INCLUSIVE PRODUCTION IN 69 GeV pp INTERACTIONS. Collaboration France-Soviet Union AIP (Amer. Inst. Phys.) Conf. Proc.; No. 12, 76-84(1973).

From conference on high energy particle interactions; Nashville, TN (26 Mar 1973).

Results are presented on 761 photon conversions into external pairs and 166 neutral strange particles decays at 69 GeV/c. The cross sections of the inclusive reactions $pp \rightarrow \gamma X$, K^0X, ΛX, are respectively 162.2 ± 8.0, 8.4 ± 1.1 and 3.6 ± 0.5 mb. The average number of π^0 per inelastic pp collisions is found to be 2.57 ± 0.13; this number increases with the number n of charged particles up to at least n = 10. Data are presented in terms of the invariant cross sections $F(x,p_\perp,s)$; scaling is approximately valid for γ, K^0, and Λ production while our data on photons are incompatible with a simple factorization of the invariant cross section $F(x,p_\perp,s) = f(x) \times g(p_\perp)$. (auth)

25757 INCLUSIVE REACTION $p + p \rightarrow p + X$ BETWEEN 40 AND 260 GeV/c USING THE INTERNAL H_2 JET TARGET AT NAL. Abe, K. (Rutgers–The State Univ., New Brunswick, NJ); De Lillo, T.; Robinson, B.; Sannes, F.; Carr, J.; Keyne, J.; Soitis, I.; Pagnamenta, A.; Stanek, R. AIP (Amer. Inst. Phys.) Conf. Proc.; No. 12, 85-98(1973).

From conference on high energy particle interactions; Nashville, TN (26 Mar 1973).

The energy dependence of the reaction $pp \rightarrow pX$ was measured over the range $s = 80$ to 480 GeV^2. It is established that the approach to scaling follows an $s^{-\frac{1}{2}}$ low and that at $s = 480$ GeV^2 the invariant cross section is about 20% above its asymptotic limit. It is found that the shape of the x distribution ($x = 1 - m^2/s$, M is the mass of X) over the range $0.79 \leq x \leq 0.94$ depends only very weakly on the incident energy. (LBS)

25758 PROTON–PROTON INELASTIC SCATTERING IN THE DIFFRACTIVE REGION AT 200 GeV. Childress, S. (Columbia Univ., New York); Franzini, P.; Lee-Franzini, J.; McCarthy, R.; Schamberger, R. Jr. AIP (Amer. Inst. Phys.) Conf. Proc.; No. 12, 99-113(1973).

From conference on high energy particle interactions; Nashville, TN (26 Mar 1973).

The doubly differential cross section $sd^2\sigma/dtdM^2$ for the reaction $p + p \rightarrow p + X$ was measured using 200 GeV incident protons in the external beam at NAL. The ranges covered in $|t|$ and M^2 are $0.019 < |t| < 0.19$ GeV^2 and $1 < M^2 < 60$ GeV^2 respectively. The hydrogen cross section was obtained by a polyethylene-carbon subtraction and is given with appropriately large statistical uncertainties. However, the cross section does show unexpected structure. In the region $7 < M^2 < 19$ GeV^2 the cross section reaches a maximum near $|t| \sim 0.1$ GeV^2 and then decreases for smaller $|t|$. (auth)

25759 LARGE TRANSVERSE MOMENTUM PRODUCTION OF GAMMA RAYS AT NAL. Carey, D. C. (National Accelerator Lab., Batavia, IL); Johnson, J. R.; Ritchie, D. J.; Roberts, A.; Shafer, R.; Theriot, D.; Walker, J. K.; Goldberg, M.; von Goeler, E.; Taylor, F. E.; Wong, M. AIP (Amer. Inst. Phys.) Conf. Proc.; No. 12, 114-120(1973).

From conference on high energy particle interactions; Nashville, TN (26 March 1973).

The single photon inclusive cross section, $d\sigma_\gamma/dk\, d\Omega$, was measured for the reaction $p + (p/n) \rightarrow \gamma +$ anything, which can be related to the inclusive π^0 cross section. The results indicate that the invariant π^0 cross section falls exponentially for transverse momenta p_T less than about 1 GeV/c. At larger transverse momenta the cross section falls more slowly. Preliminary results on the energy dependence at fixed transverse momentum are given. (auth)

25760 INTERACTION OF 200 GeV PROTON IN NUCLEAR EMULSION. Jain, P. L. (State Univ. of New York, Buffalo). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 12, 141-157(1973).

From conference on high energy particle interactions; Nashville, TN (26 Mar 1973).

Preliminary results are presented from a sample of 127 proton–nucleon inelastic interactions found by following 271 meters of track length in nuclear emulsions which were exposed to 200 GeV proton beam at NAL. Castagnoli's method of determining the primary energy from angular distribution of the secondary particles is checked. The multiplicity distribution parameters, i.e., $\langle n_{ch} \rangle$, D and f, are calculated. The prong distribution from 2 to 20 tracks is found to be broader than a Poisson's distribution. (auth)

25761 RESULTS OF LARGE TRANSVERSE MOMENTUM PHENOMENA. Busser, F. W. (CERN, Geneva); Camilleri, L.; Di Lella, L.; Gladding, G.; Placci, A.; Pope, B. G.; Smith, A. M.; Yoh, J. K.; Zavattini, E.; Blumenfeld, B. J.; Lederman, L. M.; Cool, R. L.; Litt, L.; Segler, S. L. AIP (Amer. Inst. Phys.) Conf. Proc.; No. 12, 158-168(1973).

From conference on high energy particle interactions; Nashville, TN (26 Mar 1973).

Preliminary results of an experiment on large transverse momentum phenomena performed at the CERN-ISR at center-of-mass energies of 52.7 and 44.8 GeV are presented. The topics studied were the inclusive reaction $p + p \rightarrow \pi^0 +$ "anything", where the π^0 was emitted around 90° in the center-of-mass system, ($\pi^0\pi^0$) correlations, and the charged multiplicity associated with large transverse momentum π^0's. In addition, results of a search for electrons and electron pairs are included. (auth)

25762 INCLUSIVE CHARGED PARTICLE PRODUCTION AT LARGE ANGLES AT THE CERN ISR. British-Scandinavian Collaboration. AIP (Amer. Inst. Phys.) Conf. Proc.; No. 12, 169-193 (1973).

From conference on high energy particle interactions; Nashville, TN (26 Mar 1973).

Measurements are reported of inclusive particle production at large angles in proton–proton collisions at the CERN Intersecting Storage Rings (ISR). Three different sets of results are presented: (1) Data on the inclusive production of $\pi^\pm$, $K^\pm$, p, and $\bar{p}$, at low transverse momenta over an angular range of 29° to 90°

in the center-of-mass system and for center-of-mass energies $\sqrt{s}$ = 31 and 53 GeV. (2) Results from a search for massive particles at 62.5° in the laboratory, $\sqrt{s}$ = 53 GeV — in particular, cross sections for the production of deuterons and antideuterons are given. (3) Data on inclusive charged particle production (no particle identification) of high transverse momentum p_T between 1.5 and 4.4 GeV/c, at center-of-mass angles 59.4° and 90°, $\sqrt{s}$ = 44 and 53 GeV. In addition, preliminary measurements were made at $\sqrt{s}$ = 31 and 44 GeV of $\pi^{\pm}$, $K^{\pm}$, p, and $\bar{p}$ production ratios at 90° for p_T between 2.0 and 3.5 GeV/c. The $(K^+ + p)/\pi$ ratio is given down to p_T = 1.4 GeV/c. (auth)

25763 SEARCH FOR HIGH ENERGY MULTIGAMMA EVENTS AT THE ISR. Yuan, L. C. L. (Brookhaven National Lab., Upton, NY); Dell, G. F.; Uto, H.; Amaldi, E.; Beneventano, M.; Borgia, B.; Pistilli, I.; Sestilli, I.; Dooher, J. P. AIP (Amer. Inst. Phys.) Conf. Proc.; No. 12, 194-209(1973).

From conference on high energy particle interactions; Nashville, TN (26 Mar 1973).

This is a report of the preliminary results of our exploratory experiment at the CERN ISR on the search for multigamma events in proton–proton collisions. In this experiment an overwhelmingly large number of multigamma events were observed especially at high multiplicities. The preliminary results also show a prominent peak in the energy distribution of the individual γ rays as measured by the 3-radiation lengths thick lead glass Cherenkov counters under the present triggering conditions. (auth)

25764 PARTICLE PRODUCTION AND INELASTIC PROTON SPECTRA AT THE CERN ISR. Albrow, M. G. (CERN, Geneva). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 12, 210-229(1973).

From conference on high energy particle interactions; Nashville, TN (26 Mar 1973).

Results are presented on the production of charged particles at small c.m. angles in proton-proton collisions at the CERN ISR. Scaling features are emphasized for produced particles π, K, $\bar{p}$. The inelastic proton spectra show features associated with diffractive excitation. This interpretation is supported by two-particle correlation measurements. (auth)

25765 SCALING PROPERTIES OF CHARGED PARTICLE MULTIPLICITY DISTRIBUTIONS AT THE ISR. Flugge, G. (Univ., Hamburg); Niebergall, F.; Schubert, K. R.; Schumacher, P. E.; Gottfried, C.; Neuhofer, G.; Regler, M.; Schmidt-Parzefall, W.; Winter, K. AIP (Amer. Inst. Phys.) Conf. Proc., No. 12, 230-234(1973).

From conference on high energy particle interactions; Nashville, TN (26 Mar 1973).

The multiplicity distribution of charge particles, σ_n/σ_{inel}, produced in the reaction p + p → n + anything, was measured at the ISR at four center-of-mass energies (23, 30.5, 45, and 53 GeV) over the rapidity interval $y^* = 1-4.3$ in one hemisphere. The expression $\langle n \rangle \cdot \sigma_n/\sigma_{inel}$ is found to be a function of $n/\langle n \rangle$ alone and not of s. The limiting distribution is discussed in connection with correlation among secondaries of high-energy collisions. (auth)

25766 PARTICLE PRODUCTION AT MEDIUM ANGLES AT THE CERN ISR. Antinucci, M. (Univ., Bologna); Bertin, A.; Capiluppi, P.; Giacomelli, G.; Rossi, A. M.; Vannini, G.; Bussiere, A. AIP (Amer. Inst. Phys.) Conf. Proc.; No. 12, 235-245 (1973).

From conference on high energy particle interactions; Nashville, TN (26 Mar 1973).

Experimental results are presented on the production of charge particles in inclusive reactions. The P_t, x, and y distributions are discussed. The average multiplicities are computed for π^+, π^-, K^+, K^-, p, and $\bar{p}$. (auth)

25767 SINGLE PARTICLE DISTRIBUTIONS IN INCLUSIVE π-p REACTIONS AT 10.0 AND 15.5 GeV/c. Delay, M. J.; Heller, K. J.; Miller, G.; Romer, H. F.; Rothberg, J. E.; Schenck, A.; Williams, R. W. (Univ. of Washington, Seattle). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 12, 257-276(1973).

From conference on high energy particle interactions; Nashville, TN (26 Mar 1973).

Data are presented on single particle distributions from the inclusive reactions π + p → π + ... and π + p → p + ... carried out at 10.0 and 15.5 GeV/c. All four pion charge combinations were studied at both energies. Data are available for x ≧ 0 and for transverse momenta up to 0.9 GeV/c. Positive identification of final state particles was accomplished with a Cherenkov counter and time of flight system. Production angles and momentum were measured with spark chambers, proportional chamber and a large aperture magnet. (auth)

25768 SIX GAMMA DECAY MODE OF THE $p\bar{p}$ SYSTEM AT REST. Smith, R. P. Syracuse, NY; Syracuse Univ. (1972). 235 p. University Microfilms Order No. 73-19,846. Thesis (Ph. D.).

Photographs containing six and seven gamma ray showers produced by annihilation of stopping antiprotons in liquid hydrogen were measured and kinematically analyzed. The photographs were taken from an array of large, gamma converting, optical spark chambers triggered by all-neutral final states. By presenting a gamma-gamma invariant mass spectrum from the process $\bar{p}p$ (at rest) → $2\pi^0\gamma\gamma$ conclusive evidence is given for final states corresponding to $3\pi^0$ and $2\pi^0\eta^0$ production. The branching fractions [$\bar{p}p$ (at rest) → $3\pi^0$]/[$\bar{p}p$ (at rest) → all] = (0.89 ± 0.55)% and [$\bar{p}p$ (at rest) → $2\pi^0\eta^0$]/[$\bar{p}p$ (at rest) → all] = (1.07 ± 0.67)% were measured. Dalitz plots are presented for both final states and comparisons of the $3\pi^0$ $^{1/2}$z plot are made with predictions based on recent Regge-di nodel parametrizations of the well known $2\pi^-\pi^+$ Dalitz plot p.oduced in $\bar{p}n$ annihilations at rest (auth)

Strong (Meson-induced)

Refer also to abstracts 25923 and 25933.

25769 (IFVE-SEF-72-26) ELASTIC SCATTERING OF π^-p, K^-p, AND $\bar{p}p$ AT 25 AND 40 GeV/c. Antipov, Yu. M.; Landsberg, L. G.; Ech, F. A. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Serpukhov. Institut Fiziki Vysokikh Energii). 1972. 13p. (In Russian). INIS.

The results of the measurement of the elastic scattering π^-p, K^-p, $\bar{p}p$ in the range of transmitted pulses of $0.10 < |t| < 0.40$ (GeV/c) at momenta of the primary beam of 25 and 40 GeV/c were reported. The tilt of the cone of the elastic π^-p and K^-p scattering does not change in the interval of transmitted pulses from 2 to 40 GeV/c. For $\bar{p}p$ scattering it is impossible to exclude the possibility of a small decrease of tilt parameters. (tr-auth)

25770 (JINR-P1-7157) SEARCH FOR THE χ^0-MESON IN THE DIMUON DECAYS OF K_L^0. Vovenko, A. S.; Votruba, Ya.; Gladki, Ya.; Kish, D.; Krivokhizhin, V. G.; Likhachev, M. F.; Nad, E.; Novak, M.; Prokesh, A.; Savin, I. A.; Urban, L. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1973. 8p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

It is shown that there is no evidence of the χ^0 vector meson existence arising from the $K_L^0 \to \chi^0\gamma$ decay. The upper limit of the branching ratio $\Gamma(K_L^0 \to \chi^0\gamma \to \mu^+\mu^-\gamma)/(K_L^0 \to \text{all}) < 8 \cdot 10^{-5}$ is obtained. (auth)

25771 (RLO-1388-221, pp 39-41) FLUCTUATION STUDIES IN THE LIGHTEST NUCLEUS: HYDROGEN. Carlson, D.; Johansson, E.; Lundby, A.; Schmidt, F. H. Jun 1973.

In annual report, 1973.

25772 ππ SCATTERING IN THE I = 2 CHANNEL. Kennedy, C. N.; Bloodworth, I. J.; Jackson, W. C. (Univ. of Toronto). Nucl. Phys.; B59: No. 2, 365-373(1973).

I = 2 $\pi^+\pi^+$ scattering is studied in π^+p reactions at 5.45 GeV/c. The $\pi^+\pi^+$ cross sections and phase shifts have been determined from the reaction $\pi^+p \to \pi^+\pi^+n$ using first a pure and then a modified Chew–Low extrapolation to the pion pole. (auth)

25773 $\bar{K}\pi\pi$ SYSTEM PRODUCED IN $K^-p \to \bar{K}\pi\pi N$ REACTIONS AT 14.3 GeV/c. Barloutaud, R. (CEN, Saclay, France); Borg, A.; Brun, F.; Denegri, D.; Louedec, C.; Pierre, F.; Spiro, M.; Drevillon, B.; Chaurand, B.; Labrosse, G.; Lestienne, R.; Linglin, D.; Salmeron, R. A.; Shah, T. P.; Paler, K.; Miller, R. J.; Phelan, J. J. Nucl. Phys.; B59: No. 2, 374-411(1973).

The $\bar{K}\pi\pi$ system was studied in the 14.3 GeV/c reactions $K^-p \to K^-\pi^+\pi^-p$, $K^-p \to \bar{K}^0\pi^-\pi^0p$ and $K^-p \to \bar{K}^0\pi^+\pi^-n$. The data have been obtained from a 500,000 picture exposure of the CERN 2m HBC. The first two final states are dominated by Q-production in the $K\pi\pi$ system; there is also an L-signal at M ($K\pi\pi$) ~ 1.75 GeV. The reaction cross sections are compared to K^-p data at other energies. The $K\pi\pi$ mass dependence of the diffractive production slope is discussed. Evidence is presented for a Q^-p versus Q^+p differential cross section cross-over around $|t| = 0.17$ GeV^2. A t-channel isospin analysis for the KN → K*(890)πN channels in the Q-region shows that the I = 1 exchange amplitude is ≈10% of the dominant I = 0 exchange amplitude. The $K\pi\pi$ decay distributions indicate a predominant $J^P = 1^+$ state in the Q-region, and an important $J^P = 2^-$ contribution in the L-region. Neither s-channel nor t-channel helicity conservation is found at the meson vertex in the Q- or L-regions. The Kπ angular correlation moments within the $K\pi\pi$ diffractive system are characteristic of Kπ elastic scattering, suggesting a π-exchange Deck-type production mechanism. There is evidence for a Kf^0 and κπ contribution (where κ is the $J^P(K\pi) = 0^+$ state) to the diffractive $K\pi\pi$ system. A fit to the $K^-\pi^+\pi^-$ and $\bar{K}^0\pi^-\pi^0$ Dalitz-plot distributions for the Q-region indicates that

the ratio of Kρ to K*π decay amplitudes decreases with increasing Kππ mass. (auth)

25774 LARGE-ANGLE π^+p AND K^+p ELASTIC SCATTERING AT 13.8 GeV/c. Rubinstein, R. (Brookhaven National Laboratory, Upton, New York, 11973); Cornillon, P.; Grindhammer, G.; Klems, J. H.; Mazur, P. O.; (and others). Phys. Rev. Lett. 30: No. 20, 1010-1012 (14 May 1973).

The differential cross section for π^+p elastic scattering has been measured at 13.8 GeV/c for $0.7 < |t| < 3.8$ $(GeV/c)^2$. The cross section is found to be equal to that previously obtained for π^-p elastic scattering, except in the region $|t| = 2.8$ $(GeV/c)^2$, where the π^+p data do not show the prominent dip observed in π^-p scattering. Data have also been obtained for 13.8-GeV/c K^+p elastic scattering for $0.8 < |t| < 2.2$ $(GeV/c)^2$. (auth)

25775 Σ^+ POLARIZATION IN $\pi^+N \rightarrow K^0\Sigma^+$ FROM 1.1 TO 2.4 GEV/C$. Davies, D. W.; Abilins, M. A.; Dahl, O. I.; Danburg, J. S.; Hoch, P. L.; (and others) (Lawrence Berkeley Laboratory, Berkeley, California 94720). Phys. Rev. D 7: No. 11, 3546-3548 (1 June 1973).

We observe an energy-dependent polarization of the Σ^+ produced in the reaction $\pi^+n \rightarrow K^0\Sigma^+$ at incident beam momenta between 1.1 and 2.4 GeV/c. These data are a significant source of information on the Σ^- polarization in the charge-symmetric reaction $\pi^-p \mu K^+\Sigma^-$. (auth)

25776 ANALYSIS OF PROTON FRAGMENTATION INTO TWO π^- MESONS. Stone, S. L.; Cohen, D.; Ferbel, T.; Slattery, P. F.; Werner, B. (Department of Physics and Astronomy, University of Rochester, Rochester, New York 14627); (and others). Phys. Rev. D 7: No. 11, 3532-3535 (1 June 1973).

We report on the reactions $A + p \rightarrow \pi^- + \ldots$ and $A + p \rightarrow \pi^- + \pi^- + \ldots$ where A is either a 13-GeV/c K^+ or K^- meson or a 7-GeV/c π^+ meson. We compare the distribution of final-state pions in the proton-fragmentation region with several theoretical predictions concerning limiting behavior and factorization. (auth)

25777 COMMENT ON THE CROSS SECTIONS OF THE S, T, AND U MESONS. Kienzle, W. (CERN, Geneva, Switzerland). Phys. Rev. D 7: No. 11, 3520-3521 (1 June 1973).

Absolute cross-section measurements with the CERN-IHEP Boson Spectrometer in the reaction $\pi^-p \rightarrow X^-p$ at 11 and 25 GeV/c indicate that the S, T, U cross sections obtained with the old missing-mass spectrometer (1965/66) at 12 GeV/c have been overestimated by a factor of ≈4. While this does not affect the statistical significance of the peaks, it is important for any comparison with other experiments. (auth)

25778 STRANGE-PARTICLE PRODUCTION BY π^+P AT 3.7 GEV/C. Butler, W. R.; Coyne, D. G.; Goldhaber, G.; MacNaughton, J.; Trilling, G. H. (Department of Physics and Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). Phys. Rev. D 7: No. 11, 3177-3200 (1 June 1973).

The results of a study of strange-particle production in π^+p interactions at 3.7 GeV/c are presented. Cross sections for a large number of strange-particle final states are given; the over-all strange-particle production cross section is about 1.3 mb. Comparison of cross-section results on two-body and quasi-two-body final states with corresponding π^-p data shows no evidence for exotic exchanges. Comparison of the peripheral cross sections for $\pi^+p \rightarrow K^+\Sigma^+$ and $\pi^+p \rightarrow K^+\Sigma^+(1385)$ with those for the line-reserved reactions shows reasonable agreement for $K^+\Sigma^+$ and gross disagreement for $K^+\Sigma^+(1385)$. Simultaneous $K^{*+}(891)$ $\Sigma^+(1385)$ production occurs; but, unlike its nonstrange counterpart, it is not dominated by pseudoscalar exchange. There is significant ϕ (1019) production via the reaction $\pi^+p \rightarrow \phi\pi^+p$, but none of it appears to be associated with $\Delta^{++}(1236)$. Cross sections for resonance production in various three- and four-body final states are presented. (auth)

25779 MEASUREMENT AND ANALYSIS OF THE REACTION $\pi^+P \rightarrow \eta^0\Delta^{++}$. Grether, D.; Gidal, G.; Borreani, G. (E. O. Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). Phys. Rev. D 7: No. 11, 3200-3212 (1 June 1973).

New data for the reaction $\pi^+p \rightarrow \eta^0\Delta^{++}$ are presented at 11 momenta between 1.28 and 2.67 GeV/c. Existing data at higher momenta are included in an analysis of the reaction in terms of A_2 exchange. An effective trajectory parametrization of the data above 2 GeV/c is shown to describe adequately those data, although it yields an effective trajectory steeper than expected from ρ,A_2 exchange degeneracy. An existing Regge-pole model is refitted to the data above 2 GeV/c with generally satisfactory results. Both the effective trajectory parametrization and the Regge model are extrapolated to the lower-momenta data and shown to give remarkably good agreement with the data. Evidence is presented against a dominant contribution to the lower-momenta data from s-channel resonances. (auth)

25780 STUDY OF $K^-P \rightarrow \Sigma\pi\pi$ IN THE REGION OF THE A (1520). Mast, T. S.; Bangerter, R. O.; Alston-Garnjost, M.; Barbaro-Galtieri, A.; Gershwin, L. K.; (and others) (Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). Phys. Rev. D 7: No. 11, 3212-3219 (1 June 1973).

The reactions $K^-p \rightarrow \Sigma^+\pi^-\pi^0$, $\Sigma^-\pi^+\pi^0$, and $\Sigma^0\pi^+\pi^-$ have been analyzed in the region of the Λ (1520). The data are consistent with the dominance of the reaction sequence $K^-p \rightarrow \Lambda$ (1520) $\rightarrow \Sigma$ (1385) $\pi \rightarrow \Sigma\pi\pi$. The same sequence of resonance production and decay has been previously found to lead to the $\Lambda\pi\pi$ final state. Fits to the cross sections yield branching fractions for Λ (1520) $\rightarrow \Sigma^+\pi^-\pi^0$, $\Sigma^-\pi^+\pi^0$, and $\Sigma^0\pi^+\pi^-$ of 0.0034 ± 0.0004, 0.0024 ± 0.0003, and 0.0027 ± 0.0003, respectively. A comparison of the $\Sigma\pi\pi$ and $\Lambda\pi\pi$ cross sections yields a branching ratio $\Gamma[\Sigma\ (1385) \rightarrow \Sigma\pi]/\Gamma[\Sigma\ (1385) \rightarrow \Lambda\pi] = 0.18 \pm 0.04$. (auth)

25781 ONE- AND TWO-PARTICLE INCLUSIVE-REACTION CROSS SECTIONS IN 13 GEV/C K^-P COLLISIONS. Barletta, W.; Johnson, M.; Ludlam, T.; Slaughter, A. J.; Taft, H. D. (Yale University, New Haven, Connecticut 06520). Phys. Rev. D 7: No. 11, 3233-3243 (1 June 1973).

We present data for the production of $\pi^\pm$, K^0 (or $\bar{K}^0$), Λ, and Ξ^- particles in K^-p collisions at 13 GeV/c. We examine the behavior of the longitudinal and transverse components of single-particle momentum spectra, and the two-particle correlations, as functions of the masses and quantum numbers of the observed particles. The effects of resonance production and decay on the behavior of these distributions is studied. (auth)

25782 FOUR-PION DECAY OF THE F^0 MESON. Bugg, W. M.; Condo, G. T.; Hart, E. L. (University of Tennessee, Knoxville, Tennessee 37916); Cohn, H. O.; McCulloch, R. D.; (and others). Phys. Rev. D 7: No. 11, 3264-3266 (1 June 1973).

A search for the $\pi^+\pi^+\pi^-\pi^-$ decay mode of the $f^0(1260)$ has been made in 7.87-GeV/c π^+d interactions. We find no evidence for this decay. The ratio of this decay mode relative to the dipion decay mode of the f^0 is consistent with zero and less than 3.3 % with 90% confidence. (auth)

25783 ENERGY DEPENDENCE OF THE INCLUSIVE CROSS SECTION FOR THE REACTION $\pi^+d \rightarrow \pi^-$ + ANYTHING AT LARGE TRANSVERSE MOMENTA. Anderson, J. (Carnegie-Mellon Univ., Pittsburgh); Engler, A.; Kraemer, R.; Toaff, S.; Weisser, F.; Diaz, J.; Dibianca, F.; Fickinger, W.; Robinson, D.; Sullivan, C.; Chien, C. Y.; Cox, B.; Feiock, D.; Sreedhar, V.; Zdanis, R.; Bromberg, C.; Ferbel, T.; Slattery, P. Phys. Lett.; 45B: No. 5, 521-524(20 Aug 1973).

Data are presented concerning the energy dependence of the inclusive π^- production cross section in π^+d interactions. A growth of the cross section at large momentum transfers is parametrized and compared to observations at the ISR. (auth)

25784 $I = 2\pi\pi$ SCATTERING FROM THE REACTION $\pi^-d \rightarrow \pi^-\pi^-p_s p$ AT 9.0 GeV/c. Durusoy, N. B. (Univ., Paris); Baubillier, M.; George, R.; Goldberg, M.; Touchard, A. M.; Armenise, N.; Fogli-Muciaccia, M. T.; Silvestri, A. Phys. Lett.; 45B: No. 5, 517-520(20 Aug 1973).

$I = 2$, $\pi\pi$ scattering was studied using the classical Chew–Low extrapolation method. Results are given on the cross sections and the phase shifts δ_0^2, δ_1^2 and δ_2^2 up to 2.2 GeV, δ_0^2 values are $-7.8 \mp 3.0°$ at the K^0 mass, $-15 \mp 1.5°$ at the ρ mass and $-29.0 \mp 2.2°$ of the f^0 mass. Above the f^0 mass $|\delta_0^2|$ decreases. (auth)

25785 STRUCTURE IN THE K^+–NUCLEON $I = 0$ TOTAL CROSS SECTION BELOW 1.1 GeV/c. Carroll, A. S.; Kycia, T. F.; Li, K. K.; Michael, D. N.; Mockett, P. M.; Rahm, D. C.; Rubinstein, R. (Brookhaven National Lab., Upton, NY). Phys. Lett.; 45B: No. 5, 531-534(20 Aug 1973).

Measurements were carried out of total cross sections of positive kaons on hydrogen and deuterium to a statistical precision of better than ±0.1 mb for most points in the range of laboratory momentum from 410 to 1065 MeV/c in intervals of approximately 50 MeV/c. A very broad elastic structure in the $I = 0$ state is inferred. (auth)

25786 RESONANCE STRUCTURE IN $K^-N \rightarrow Y\pi$ REACTIONS IN THE CENTER OF MASS ENERGY RANGE 1550 TO 1650 MeV. Morris, W. A. Tallahassee, FL; Florida State Univ. (1973). 86p. University Microfilms Order No. 73-21,349.

Thesis (Ph. D.).

The cross sections are determined for the reactions $K^-n \rightarrow \Sigma^-\pi^0$, $K^-n \rightarrow \Lambda^0\pi^-$, $K^-n \rightarrow \Lambda^0\pi^-\pi^0$, and $K^-n \rightarrow \Sigma^0\pi^-$ in the center of mass energy range 1550–1650 MeV. An energy-dependent partial wave analysis is made of the two-body final states, and evidence is presented for an $I = 1$, $S = -1$ baryon resonance at 1625 MeV with a full width of 45 MeV. A spin-parity assignment of $\frac{1}{2}^-$ is made for this resonance. (auth)

25787 π^-p INTERACTIONS AT 200 GeV/c. Bogert, D. (National Accelerator Lab., Batavia, IL); Hanft, R.; Huson, F. R.; Ljung, D.; Pascaud, C.; Pruss, S.; Smart, W. M.; Abrams, G.;

Daugeras, B.; Friedberg, C.; Goldhaber, G.; Johnson, D.; Kadyk, J.; Trilling, G.; Winklemann, F.; Bingham, H.; Chew, D.; Fretter, W.; Graves, W.; Stutte, L.; Yost, G. AIP (Amer. Inst. Phys.) Conf. Proc.; No. 12, 60-75(1973).

From conference on high energy particle interactions; Nashville, TN (26 Mar 1973).

Preliminary results give an average multiplicity of 8.0 ± 0.17 and a total cross section of 24.0 ± 0.5. It is found that approximately 20% of the 4-prong events fit the hypothesis $\pi^- p \to p\pi^-\pi^+\pi^-$ and that essentially all of these are either beam diffraction into $\pi^-\pi^+\pi^-$ or target diffraction into $p\pi^+\pi^-$. (auth)

25788 INCLUSIVE PRODUCTION OF HIGH ENERGY NEUTRAL PIONS IN PION–PROTON COLLISIONS AT 14 GeV/c. O'Neill, L. H. (Stanford Univ., CA); Ford, R. L.; Crawford, J. F.; Hofstadter, R.; Hughes, E. B.; Schilling, R. F.; Wedemeyer, R. AIP (Amer. Inst. Phys.) Conf. Proc.; No. 12, 246-256(1973).

From conference on high energy particle interactions; Nashville, TN (26 Mar 1973).

Differential cross sections for the inclusive production of high energy neutral pions in the reactions $\pi^\pm p \to \pi^0 X$ were measured at an incident $\pi^\pm$ laboratory momentum of 14 GeV/c. The measurements were made at the Stanford Linear Accelerator Center using two large NaI(Tl) γ ray spectrometers. The kinematic region covered is approximately $0.2 \le x \le 1$ and $0 \le Q \le 0.7$ GeV/c. The differential inclusive cross sections for incident π^+ and π^- are found to be approximately equal to each other and, for $x > 0.5$, to be about 30% of the inclusive cross section for $\pi^- p \to \pi^+ X$. For $x < 0.3$ the inclusive π^0 and π^- cross sections approach equality. (auth)

25789 $\eta'(960)$ PRODUCED IN THE REACTION $K^- p \to \Lambda\eta' \to \Lambda\pi^+\pi^-$ + NEUTRALS. Jacobs, S. M. Syracuse, NY; Syracuse Univ. (1972). 95p. University Microfilms Order No. 73-19,825.

Thesis (Ph. D.).

The $\eta'(960)$ was studied in the reactions $K^- p \to \Lambda\eta', \eta' \to \pi^+\pi^-\eta_N(\eta_N \to$ neutrals) and $\eta' \to \pi^+\pi^-\gamma$ from a 15.4 events/μb experiment. Additional evidence is presented for favoring the $J^P = 0^-$ assignment. The branching ratio, determined independent of channel separation, of $(\pi^+\pi^-\gamma/\pi^+\pi^-\eta)$ is found to be 1.11 ± 0.18. For the determination of cross sections, a method for separating Λ and Σ^0 ambiguities based on their physical properties is presented. (auth)

25790 ANALYSIS OF Kπ PHASE SHIFTS FROM $K^- p$ INTERACTIONS AT 2.87 GeV/c. Glickman, S. L. Syracuse, NY; Syracuse Univ. (1972). 668p. University Microfilms Order No. 73-19,811.

Thesis (Ph. D.).

The $I = 3/2$ and $I = 1/2$ s-wave Kπ scattering phase shifts in the 0.65 to 1.4 GeV range are calculated for $K^-\pi^0 \to \bar{K}^0\pi^-$, from angular distributions and cross sections extracted from the reactions $K^- p \to \bar{K}^0\pi^- p$; $\bar{K}^0\pi^- p\pi^0$; and $\bar{K}^0\pi^- n\pi^+$, at 2.87 GeV/c K^- beam momentum, by the Chew-Low extrapolation method. Some analysis of these reactions is done to determine their suitability for use in this procedure. Best results are obtained using the reaction $K^- p \to \bar{K}^0\pi^- p\pi^0$, which is seen to proceed largely by a peripheral mechanism, in particular $K^- p \to K^*(890)\,\Delta^+(1236)$, and show evidence for a narrow resonance at 0.87 GeV. Previous evidence for $I = 3/2$ s-wave resonance behavior in the 1.2 GeV region is not contradicted. (auth)

25791 $\pi\pi$ AND Kπ SCATTERING STUDIES WITH THE ARGONNE EFFECTIVE MASS SPECTROMETER. Ayres, D. S.; Diebold, R.; Greene, A. F.; Kramer, S. L.; Pawlicki, A. J.; Wicklund, A. B. (Argonne National Lab., IL). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 13, 284-297(1973).

From international conference on $\pi-\pi$ scattering and associated topics; Tallahassee, Florida (28 Mar 1973).

A total of 580,000 events of the type $\pi^- N \to \pi^-\pi^+ N$ was obtained in the region 3 to 6 GeV/c. Isolation of $\rho\omega$ interference is made in a straightforward way by using both π^+ and π^- beams with a deuterium target. An amplitude analysis of ρ^0 production at 6 GeV/c yields results similar to those previously found at 17 GeV/c, except that the natural-parity exchange contribution is relatively less important. Results on $K^+ n \to K^+\pi^- p$ and $\pi^- p \to K^- K^+ n$ are also discussed. (auth)

25792 NEW DIRECTIONS IN $\pi\pi$ AND Kπ EXPERIMENTS. Status of a 13 GeV $K^+ p$ Experiment at SLAC. Carnegie, R. K. (Stanford Univ., CA). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 13, 298-301(1973).

From international conference on $\pi-\pi$ scattering and associated topics; Tallahassee, Florida (28 Mar 1973).

A new SLAC experiment to study Kπ scattering using both $K^+ p$ and $K^- p$ reactions at 13 GeV is described. (auth)

25793 $\pi\pi$ PHASE SHIFT ANALYSIS FROM AN EXPERIMENT $\pi^- p \to \pi^0\pi^0 n$ AT 2 GeV/c SUPPLEMENTED BY $\pi^+\pi^-$, $\pi^-\pi^0$, $\pi^\pm\pi^\pm$ FINAL STATES. Villet, G.; David, M.; Ayed, R.; Bareyre, P.; Borgeaud, P.; Ernwein, J.; Feltesse, J.; Lemoigne, Y.; Marty, P.; Stirling, A. V. (CEN, Saclay, France). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 13, 307-311(1973).

From international conference on $\pi-\pi$ scattering and associated topics; Tallahassee, Florida (28 Mar 1973).

$\pi^+\pi^- \to \pi^0\pi^0$ elastic and differential cross sections from threshold to 1 GeV $\pi\pi$ mass were obtained by Chew-Low extrapolation methods from the reaction $\pi^- p \to \pi^0\pi^0 n$ at 2 GeV/c. Large $J = 0$ production approaching the unitarity limit in the 450–750 MeV $\pi\pi$ mass is found. An energy-independent phase shift analysis up to F waves using both the $\pi^0\pi^0$ final state and the already known $\pi^\pm\pi^\pm$, $\pi^-\pi^0$, $\pi^+\pi^-$ states (giving $I = 0,1,2$) verifies the overall consistency of the experimental data. Supplemented by the use of forward dispersion relations the phase shift analysis gives a unique solution characterized by the scattering lengths $a_0^0 = 0.67$ and $a_0^2 = 0.021$ and by the presence of an ϵ ($J = I = 0$) of mass 940 MeV and width 180 MeV. (auth)

25794 $\pi-\pi$ PHASE SHIFTS IN THE ENERGY REGION 0.6 TO 1.42 GeV. Toaff, S. (Carnegie-Mellon Univ., Pittsburgh); Anderson, J. C.; Engler, A.; Kraemer, R. W.; Weisser, F.; Diaz, J.; DiBianca, F. A.; Fickinger, W.; Robinson, D. K.; Sullivan, C. A. AIP (Amer. Inst. Phys.) Conf. Proc.; No. 13, 312-316(1973).

From international conference on $\pi-\pi$ scattering and associated topics; Tallahassee, Florida (28 Mar 1973).

Results are presented on $\pi-\pi$ scattering via the reaction $\pi^+ n \to \pi^+\pi^- p$ at 6 GeV/c. Using a one-pion exchange model modified by absorption and $I = 2$ phase shifts from other experiments S, P, and $\pi-\pi$ phase shifts were extracted under certain energy dependent assumptions. The data sample consists of approximately 13000 events in the energy region 0.6 to 1.42 GeV. (auth)

25795 PRODUCTION OF ρ^0 AND f^0 IN 4 GeV/c $\pi^+ d$ INTERACTIONS. Charlesworth, J. A. (Rutherford High Energy Lab., Chilton, Eng.); Sekulin, R. L.; Emms, M. J.; Kinson, J. B.; Riddiford, L.; Stacey, B. J.; Vartruba, M. F.; Woodworth, P. L.; Bell, I. G.; Dale, M.; Major, J. V. AIP (Amer. Inst. Phys.) Conf. Proc.; No. 13, 317-321(1973).

From international conference on $\pi-\pi$ scattering and associated topics; Tallahasse, Florida (28 Mar 1973).

The Estabrooks and Martin analysis was applied to a sample of 5279 events produced in the reaction $\pi^+ n \to p\rho^0$, and a density matrix study, including a positivity analysis, of the $J = 0, 1, 2$ density matrix in the f^0 region was made using a sample of 2385 events. (auth)

25796 PRELIMINARY RESULTS OF CHEW–LOW EXTRAPOLATIONS USING $\pi^- p \to \pi^-\pi^+ n$ AT 4.5 GeV/c. Jacques, P.; Barish, S.; Bensinger, J.; Hearn, M.; Kononenko, W.; O'Neill, E. M.; Selove, W. (Univ. of Pennsylvania, Philadelphia). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 13, 322-326(1973).

From international conference on $\pi-\pi$ scattering and associated topics; Tallahassee, Florida (28 Mar 1973).

About 8,600 $\pi^-\pi^+ n$ events, from 110,000 2-prong events, were analyzed using several forms of Chew–Low extrapolation. The results are compared on the basis of chi-square probabilities, stability against change in the upper limit in $-t$ used smoothness of $\sigma_{\pi\pi}$ as a function of $M_{\pi\pi}$, and agreement with the unitarity limit for $\sigma_{\pi\pi}$ at the ρ mass. (auth)

25797 ISOSPIN 2 $\pi\pi$ PHASE SHIFTS FROM AN EXPERIMENT $\pi^+ p \to \pi^+\pi^+ n$ AT 12.5 GeV/c. Grayer, G. (CERN, Geneva); Hyams, B.; Jones, C.; Weilhammer, P.; Blum, W.; Dietl, H.; Koch, W.; Lorenz, E.; Luetjens, G.; Maenner, W.; Meissburger, J.; Stierlin, U.; Hoagland, W. AIP (Amer. Inst. Phys.) Conf. Proc.; No. 13, 337-341(1973).

From international conference on $\pi-\pi$ scattering and associated topics; Tallahassee, Florida (28 Mar 1973).

The $I = 2$ s- and d-wave $\pi\pi$ phase shifts δ_s^2 and δ_d^2 were determined in the $\pi\pi$ mass region from 500-1500 MeV, using a sample of 17,500 events $\pi^+ p \to \pi^+\pi^+$ from a spark chamber experiment. For this purpose the moments of the $\pi\pi$ angular distribution in the s-channel helicity frame were written as bilinear expressions of OPE amplitudes modified by absorption and were fitted to the measured values of the moments in four mass bins of width 0.25 GeV/c^2. The value of δ_s^2 in the ρ-mass region ($\delta_s^2 \simeq -15.5°$) corresponds to an elastic cross section of ≃7.5 mb. The values of δ_d^2 are about a factor of 10 smaller than the corresponding values of δ_s^2 for the whole mass region considered. (auth)

25798 STRUCTURE IN THE MOMENTUM TRANSFER DISTRIBUTION OF $\pi^- + p \to \rho + N$ AT 2.3 GeV/c. Hagopian, S. (Florida State Univ., Tallahassee); Hagopian, V.; Selove, W. AIP (Amer. Inst. Phys.) Conf. Proc.; No. 13, 354-356(1973).

From international conference on $\pi-\pi$ scattering and associated topics; Tallahassee, Florida (28 Mar 1973).

The data from $\pi^- + p \rightarrow \rho^0 + n$ and $\pi^- + p \rightarrow \rho^- + p$ at 2.3 GeV/c is consistent with a dip in $d\sigma/dt$ at $t \sim -0.6$ $(GeV/c)^2$ for ρ^- production and a break at $t \sim -0.6$ $(GeV/c)^2$ for ρ^0 production, in agreement with theoretical predictions and some other experiments. (auth)

Particle Interactions and Properties (Theoretical)

25799 (COO-2009-57) THEORETICAL PARTICLE PHYSICS. Progress Report, December 1, 1972–November 30, 1973. Chu, S. Y.; Hendry, A. W.; Lichtenberg, D. B. (Indiana Univ., Bloomington. Dept. of Physics). 1973. Contract AT(11-1)-2009. 14p. Dep. NTIS $3.00.

Work in theoretical particle physics was done in a variety of subjects. A major effort went into a phenomenological description of high-energy elastic scattering. Using an s-channel description in which the partial wave amplitudes were parametrized as smooth functions in impact parameter space, good fits to the differential cross sections and polarizations were obtained, including the πp and pp data of the Indiana University spark-chamber group (Task A of this Contract). Phenomenological work was also done in characterizing strong-interaction resonances. Empirical relations among the masses, widths, and elasticities of resonances were found, and these relations were partially accounted for in terms of the Veneziano model. Further work on resonances was the development of a new parametrization which emphasizes the position of the pole in the relevant S-matrix. Finally, a new approach to five-dimensional general relativity was proposed. (auth)

25800 MOESSBAUER EFFECT ON NEUTRINO AND LIMITS ON ELEMENTARY LENGTH. Andryushin, V. I.; Melnikov, V. N. (State Committee of Standards, Moscow). Lett. Nuovo Cim.; 7: No. 16, 809-810(18 Aug 1973).

Suggestions concerning the experimental detection of the elementary length based on the Moessbauer effect are discussed. (LBS)

25801 ELECTRON-POSITRON ANNIHILATION FROM THE LIGHT CONE. Mason, A. L. (Physics Department, University of Illinois at Urbana–Champaign, Urbana, Illinois 61801). Phys. Rev. D 7: No. 12, 3799-3807 (15 June 1973).

We show how to use light-cone expansions and the Callan–Symanzik equation to calculate some structure functions of nonforward virtual Compton amplitudes in renormalizable field theories. By making an analytic continuation of the discontinuity we arrive at integral equations for e^+e^- annihilation structure functions. These are equivalent to equations previously found by Gribov and Lipatov by direct summation of diagrams. (auth)

25802 ATOM–ANTIATOM INTERACTIONS. Morgan, D. L. Jr.; Hughes, V. W. (Gibbs Laboratory, Physics Department, Yale University, New Haven, Connecticut 06520). Phys. Rev. A 7: No. 6, 1811-1825 (June 1973).

Atom–antiatom rearrangement collisions in which the nucleus–antinucleus bound state is formed are important processes in atom–antiatom interactions. We give a general discussion of the atom–antiatom interatomic potential energy V and calculate V for H–$\bar{H}$, $\bar{p}$–H, and $\bar{M}$–Ar where $\bar{M}$ means antimuonium (μ^-e^+ atom). We apply the semiclassical and optical-potential methods to determine cross sections for rearrangement collisions. At low energies these collisions are the dominant processes leading to particle–antiparticle annihilation. (auth)

General

Refer also to abstract 26450.

25803 (NP-19827) PROGRESS REPORT FOR THE PERIOD JULY 1971–DECEMBER 1972. (Nordisk Institut for Teoretisk Atomfysik, Copenhagen (Denmark)). [nd]. 39p. (In Danish and English). Dep. NTIS (U. S. Sales Only) $4.00.

Research in high energy and nuclear physics is summarized. A list of publications is included. (JFP)

25804 LAGRANGIANS FOR HIGHER SPIN FIELDS WITHIN THE FRAMEWORK OF THE GEL'FAND–NAIMARK FORMALISM. Frank, V. (Univ., Karlsruhe, Ger.). Nucl. Phys.; B59: No. 2, 429-444(1973).

The method of Gel'fand and Naimark is used to find Lagrangians for particles of spins $^3/_2$, 2 and $^5/_2$. (auth)

25805 DETERMINATION OF STATISTICAL TENSORS IN SEQUENTIAL DECAYS. Kotanski, A.; Sredniawa, B. (Jagellonian Univ., Krakow). Acta Phys. Pol.; B4: No. 4, 421-531(1973).

It is shown how to determine statistical tensors from the angular distributions in the decays where one of the decay products decays in turn. All tensor components may be estimated by this method, even the components of tensors T^L_M with odd L (e.g., Im ρ_{10} for spin 1 particles) which cannot be measured by the usual method of moments. In addition, the decay amplitudes can be found if there is more than one coupling constant, like for spin 2 particles. Examples of decays of particles with the following spins are discussed: $1^+ \rightarrow 0^+ + (1^- \rightarrow 0 + 0)$, $2^- \rightarrow 0^- + (1^- \rightarrow 0 + 0)$, $^3/_2^- \rightarrow 0^- + (^3/_2^+ \rightarrow ^1/_2 + 0)$, $2^- \rightarrow 0^- + (2^+ \rightarrow 0 + 0)$ and $1^+ \rightarrow 0^- + 2^+ \rightarrow 0 + 0)$. (auth)

25806 POSSIBILITY OF MASSLESS PARTICLE INSTABILITY. Parkinson, M. T.; Vasholz, D. P. (Univ. of Florida, Gainesville). Phys. Lett.; 45B: No. 4, 376-378(6 Aug 1973).

It is shown that phase restrictions along with the application of known conservation laws allow only massless particle decay involving two photons and a graviton. These results are reexamined from an alternative viewpoint emphasizing virtual processes. (auth)

25807 SIMPLE PHYSICAL INTERPRETATION OF THE CRITICAL DIMENSION OF SPACE–TIME IN DUAL MODELS. Brink, L. (CERN, Geneva); Nielsen, H. B. Phys. Lett.; 45B: No. 4, 332-336(6 Aug 1973).

The energy due to zero point fluctuations of the dual string is calculated and shown to be divergent. It is made finite by introducing a cut-off. The result is non-covariant but invariant under reparametrization, so one has to modify the classical Lagrangian so as to get a covariant result. It is then shown that this leads to the well-known relation relating the mass squared of the lowest state to the number of dimensions of space-time. This result is independent of the cut-off and shows clearly the physical significance of the critical dimension of space-time. Similar considerations for the Neveu–Schwarz model are also discussed. (auth)

25808 CURRENT-ALGEGRA THEOREMS FOR ANOMALOUS VERTICES. Brown, S. G. (Institute for Theoretical Physics, State University of New York at Stony Brook, Stony Brook, New York 11790). Phys. Rev. D 7: No. 12, 3680-3686 (15 June 1973).

We show that in the chiral-symmetric limit all irreducible vertices which have anomalous contributions of order k in the momenta are predicted by normal Ward identities to vanish through order k in the momenta; i.e., normal and anomalous contributions are mutually exclusive. We also generalize Wilson's discussion of the π^0 anomaly to show that the irreducible odd-parity vertices which are anomalous are those with n currents ($n \leq 4$) and any number of pions, and that these anomalies are of order 4–n in the momenta. (auth)

25809 AVERAGE MULTIPLICITY, SECONDARY TRAJECTORY, AND MUELLER ANALYSIS. Tow, D. M. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). Phys. Rev. D 7: No. 11, 3535-3539 (1 June 1973).

The correlation to the average multiplicity is calculated in a general Mueller analysis when a secondary Regge trajectory with intercept (1/2) is also included. $\langle n \rangle$ is then approximately given by $[A \ln s + B + Cs^{(-1/2)}]$, which fits well all existing multiplicity data from $s = 25$ to 2800 GeV^2. We show that part of the coefficient C may be estimated from the 90 ° production data. We comment on the sensitivity (or insensitivity) of $\langle n \rangle$ as a test of production models. (auth)

25810 INCLUSIVE TWO-PARTICLE CORRELATION AND THE STATISTICAL MODEL. Jabs, A. (Universität Trier–Kaiserslautern, Fachbereich Physik, D–675 Kaiserslautern, Germany). Phys. Rev. D 7: No. 11, 3368-3371 (1 June 1973).

The fully integrated inclusive two-particle correlation function, $f_2 = \langle n(n-1) \rangle - \langle n \rangle^2$, with n=number of particles, is known to take on positive values in collisions with sufficiently high energy. It is shown that the statistical model in its simplest versions gives negative values for f_2 but that the correct tendency can be obtained naturally by taking into account fluctuations in inelasticity or by subdividing the multiparticle production into two processes, e.g., pionization and fragmentation, with pionization described by the statistical model. (auth)

25811 FINITE-ENERGY UPPER LIMIT FOR TOTAL CROSS SECTION. Lomsadze, Yu. M.; Drobnich, V. G. Ukr. Fiz. Zh. (Russ. Ed.); 18: No. 6, 994-999(Jun 1973). (In Russian).

An upper limit for $\sigma_{tot}(s)$ is obtained in terms of $a(s) = \sigma_{el}(s)/\sigma_{tot}(s)$ and logarithmic derivative of the imaginary part of the forward scattering amplitude by the generalized Lagrange multiplier rule. Use is made of the unitarity condition and the decomposibility of the experimental amplitude in partial waves. The result is valid for finite energies s and as a means for ex-

perimental verification of theory principles, it strengthens the McDowell–Martin upper limit in the region $a(s) \geq 2/3$. (auth)

25812 QUANTUM FIELD THEORY FOR THE EXPONENTIAL TYPE BOSON SELF INTERACTIONS IN TWO SPACE-TIME DIMENSIONS. Park, Y. M. Bloomington, IN; Indiana Univ. (1973). 118p. University Microfilms Order No. 73-19,744.

Thesis (Ph. D.).

A class of boson self-interactions in two dimensional space-time is studied with interaction density of the form $H(\varphi(x)) = \int d\nu(s) : e^{s\varphi(x)} :$ where $\nu(s)$ is a positive measure with support in $\{s \mid |s| < \sqrt{2\pi}\}$. The space cutoff interaction Hamiltonian $H_1(g) = \int dx\, g(x) H(\varphi(x))$ is defined as the strong limit of polynomial interactions in Fock space. The local Hamiltonian $H(g) = H_0 + H_1(g)$, where H_0 is the free boson energy, is essentially self-adjoint on $D(H_0) \cap D(H_1(g))$, and $H(g)$ has a unique vacuum vector Ω_g and the continuous spectrum begins at the same point as for H_0. The Heisenberg field operators $\varphi_g(f)$ and $\pi_g(f)$ are self-adjoint and independent of the space cutoff g if f has compact support. The field satisfies the field equation. It is also proved that all of the Haag-Kastler axioms are satisfied in this model. The physical Hilbert space, F_{phys}, constructed by removal of space cutoffs ($g \to 1$) is the representation space for the algebra of bounded functions of the field operator $\varphi(f)$. The representation is locally Fock. In F_{phys} the renormalized Hamiltonian H and the field operator $\varphi_{phys}(f)$, $f \in C_0^\infty(R^2)$, exist. (auth)

25813 PERSPECTIVES ON CORRELATIONS: DE OMNI RE SCIBILI, ET QUIBUSDAM ALIIS. Quigg, C. (State Univ. of New York, Stony Brook). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 12, 375-403(1973).

From conference on high energy particle interactions; Nashville, TN (26 Mar 1973).

The implications of recent experimental findings on correlations in rapidity among produced particles are assessed. Present evidence indicates that on the central plateau a short-range correlation picture is strongly favored over a fragmentation scheme. In search of shortcomings of a naive description of short-range correlations the Mueller–Regge formalism is extended beyond reasonable bounds of credibility, but on the central plateau no inconsistencies are found. (auth)

Electromagnetic

Refer also to abstracts 25997 and 26458.

25814 (COO-1545-132) ρ-A_2 EXCHANGE DEGENERACY AND THE ADLER SUM RULE. Wada, W. W. (Ohio State Univ., Columbus. Dept. of Physics). 1973. Contract AT(11-1)-1545. 13p. Dep. NTIS $3.00.

On the basis of ρ-A_2 exchange degeneracy, the structure functions for virtual Compton scattering with I = 1 and C = ±1 in the t-channel are assumed proportional to one another. The constant of proportionality is determined by the threshold relation of Bloom and Gilman. The Adler sum rule (I = 1, C = −1) is found to be consistent with the observed behavior of the structure function (I = 1, C = +1) in the scaling region. A simple proportionality relation between $\nu(W_2^{\bar{p}p} - W_2^{pp})$ and $\nu(W_2^{\bar{n}p} - W_2^{np})$ is obtained in the scaling limit. (auth)

25815 (DESY–73/18) INELASTIC SCATTERING OF ELECTRONS ON NUCLEONS. Heinloth, K. (Deutsches Elektronen Synchrotron, Hamburg (West Germany)). May 1973. 53p. (In German). Dep. NTIS (U.S. Sales Only) $4.75.

From spring meeting of the Deutsche Physikalische Gesellschaft; Heidelberg, Germany (21 Feb 1973).

A report is given on selected experiments in inelastic electron–nucleon scattering as well as their implications for the electromagnetic structure of the hadrons and the hadronic structure of the photon. After a survey on elastic electron–nucleon scattering which gives information on the electromagnetic structure of the nucleon, the following types of experiments are discussed: measurement of the total cross section for hadron production by means of virtual photons; inclusive hadron production for the reaction $e + p \to e + \pi^+ +$ anything as an example; exclusive hadron production for the reaction $e + p \to e + p + (\rho)^0$ as an example. (GE)

25816 (EFI-TF–5(71)) PHOTOPRODUCTION OF X^0-MESON IN PERIPHERAL MODEL. Matinyan, S. G.; Shakhnazaryan, Yu. G. (Akademiya Nauk Armyanskoi SSR, Erevan. Institut Fiziki). 1972 11p. INIS.

On the basis of Dar, Watts, and Weisskopf "new peripheral model" photoproduction of X^0 from nucleons is considered. The dependences of the cross section $d\sigma/dt(\gamma p \to pX^0)$, of the ratio $d\sigma/dt(\gamma n \to nX^0)/d\sigma/dt(\gamma p \to pX^0)$, and of the asymmetry ratio connected with the linear polarization of the photons on the square of momentum transfer t at various energies are obtained. (auth)

25817 (SLA-73-5548-B) TIME-DEPENDENT MULTICHANNEL COULOMB SCATTERING THEORY. Chandler, C.; Gibson, A. G. (New Mexico Univ., Albuquerque). 1973. 18p. Dep. NTIS $4.00.

The formulation by Mulherin and Zinnes of two-particle Coulomb scattering theory is extended to the multichannel case. The wave operators so obtained are proved by a direct method to be identical with those of Dollard. (auth)

25818 THEORY OF RADIATING ELECTRONS. Asby, R. (Royal Holloway Coll., London). pp 509-521 of Coherence and Quantum Optics. Mandel, L. (ed.). New York; Plenum Publishing Corp. (1973).

From 3rd Rochester conference on coherence and quantum optics; Rochester, NY (21 Jun 1972).

Dirac previously showed that the self force on a point electron could be calculated in a consistent manner by assuming that it was due to just part of the field of the electron. It is discussed how this theory and the Lorentz–Dirac equation may be derived for each particle of a system of particles using the principle of least action from a given action integral. (JFP)

25819 SIMPLE DERIVATIONS OF CROSS SECTIONS AND DECAY FORMULAS FOR LEPTON–HADRON REACTIONS. Actor, A. (Univ., Heidelberg). Lett. Nuovo Cim.; 7: No. 17, 905-910 (25 Aug 1973).

A formalism similar to a previous one is developed for electron–hadron scattering. But the notation is more flexible, and the derivations are simpler. Without explicit Lorentz-group manipulations, detailed final formulas are written complete with expressions for all relevant kinematic parameters in terms of Lorentz scalar products of available four-momenta. Only the central algebraic problem is discussed. The cross sections for the electroproduction e + N, and neutrino production ν + N processes are discussed. (JFP)

25820 DUALITY AND ELECTRON–POSITRON ANNIHILATION AT HIGH ENERGY. Chaichian, M. (Univ. of Bielefeld, Ger.); Satz, H.; Kitakado, S. Nuovo Cim.; 16A: No. 3, 437-444 (1 Aug 1973).

General constraints of duality are applied to annihilation processes $e^-e^+ \to h +$ anything, where h stands for meson or baryon octets. All planar dual terms, as well as a possible background contribution are considered. The interrelation of duality and dominance of specific terms is investigated. (auth)

25821 π^+/π^- ASYMMETRY IN INCLUSIVE ELECTROPRODUCTION OF HADRONS. Cleymans, J. (Technische Hochschule, Aachen). Nuovo Cim.; 16A: No. 3, 445-448(1 Aug 1973).

Mueller's Regge analysis, combined with the so-called generalized scaling laws of the parton model, predicts an increase in the π^+/π^- asymmetry in the photon fragmentation region for increasing Q^2 when all other relevant variables are kept fixed. (auth)

25822 HOW TO MEASURE THE DIMENSION OF THE PARTON FIELD. Parisi, G. (CNEN, Frascati, Italy). Nucl. Phys.; B59: No. 2, 641-646(1973).

It is shown that the anomalous dimension of the fundamental field is connected to the anomalous dimensions of the high spin bilinear operators. The dimensions of these operators can be determined by examining the violations of the Bjorken scaling law in deep-inelastic electron-proton scattering. The structure function at field ω near to one has a power dependence of q^2, the exponent being the anomalous dimension of the "parton" field. (auth)

25823 PROPORTIONALITY OF HADRONS AND ELECTROMAGNETIC AMPLITUDES. Genz, H. (Univ., Karlsruhe, Ger.); Schmidt, W. Nucl. Phys.; B59: No. 2, 629-640(1973).

Our starting point is the experimentally observed proportionality $\frac{1}{2}(\sigma_{tot}^{\pi^+p} + \sigma_{tot}^{\pi^-p}) \approx 220\ \sigma_{tot}^{\gamma N}$. In view of this approximate equality a relation between the isovector photon forward Compton amplitude and the forward, isospin-even, πN scattering amplitude with zero-mass pions is conjectured. The approximate scale factor is derived $1/220$ by using the Cheng–Dashen extrapolation and the Hoehler–Jakob–Strauss value of the σ-term in πN scattering. Apparent discrepancies are discussed and shown to be predominantly due to mass-extrapolation effects. A notable analogy to the Gell-Mann–Fritzsch light-cone algebra is pointed out. (auth)

25824 PROTON–NEUTRON STRUCTURE-FUNCTION DIFFERENCE IN THE RESONANCE REGION. Kowalski, H.; Roemer, H.; Rubinstein, H. R. (Weizmann Inst. of Science, Rehovot, Israel). Nucl. Phys.; B59: No. 2, 589-599(1973).

A detailed analysis of the different structure functions νW_2 for deep-inelastic scattering of protons and neutrons is performed by means of the recent photoproduction phase-shift analysis of Moorhouse–Oberlack and a theoretical model for multipion pro-

duction. The low-energy data taken as a function of ω_W, are known to average the difference of the deep-inelastic structure functions, which in turn is related to the imaginary part of an $I_t = 1$ forward Compton amplitude with one isovector and one isoscalar photon. The main results are: (i) It is established by two independent calculations that the imaginary part of the $I_t = 1$ Compton amplitude is entirely generated by resonances. (ii) The $I_t = 1$ imaginary part of the Compton amplitude is generated by only the resonant parts of the exclusive channels; the non-resonant multipoles do not contribute. Large real parts of the amplitudes in the exclusive channels, which are demanded by gauge invariance, cancel in the p-n difference. (iii) A positive contribution of the non-resonant incoherent 2π production near threshold to the difference of the proton and neutron structure functions is predicted. (auth)

25825 RESONANCES AND PARTONS AS TWO COMPLEMENTARY WAYS TO DESCRIBE THE DEEP INELASTIC PHENOMENA. Pavkovic, M. I. (New York Univ., NY). Lett. Nuovo Cim.; 7: No. 17, 925-930(25 Aug 1973).

It is shown explicitly how by starting from what is essentially a resonance saturation scheme, the Dashen–Gell-Mann program of current algebra, one can derive all important results of the parton model, including scaling, the characteristic representation for the F_2-function sum rules, etc. Deep inelastic electron-nucleon scattering is considered. (JFP)

25826 EQUATIONS OF MOTION OF A CLASSICAL PARTICLE WITH SPIN. Linet, B. (Institut Henri Poincare, Paris). Lett. Nuovo Cim.; 8: No. 1, 63-66(1 Sep 1973). (In French).

A point particle with spin and a magnetic moment in interaction with a given electromagnetic field is considered. One can deduce the general equations of motion from the energy–momentum conservation law, assuming a dipolar decomposition of the electric current and the energy–momentum tensor. It is shown that the equations of motion are equivalent to a differential system the form of which is adapted to the resolution of the Cauchy problem. (JFP)

25827 CONFORMAL INVARIANCE, SINGULAR BILOCAL OPERATORS AND SCALING IN SOME DEEP INELASTIC-SCATTERING AND ANNIHILATION PROCESSES. Chowdhury, A. R.; Chowdhury, R. K. R. (Jadavpur Univ., Calcutta). Lett. Nuovo Cim.; 8: No. 1, 53-56(1 Sep 1973).

The problem of the proper character of the bilocal operators measured in deep inelastic processes is analyzed using conformal invariance and previous techniques. The processes $e^+ + e^- \rightarrow \pi +$ anything and $e^- + p \rightarrow e^- + \pi +$ anything are considered. Two different characters of the bilocal operators are exhibited. It is found that the conformal invariance reproduces the observed scaling behaviors simultaneously helping to fix the dimension of the fields involved. Also a clear indication is given that matrix elements of bilocal operators between hadron states may be singular. (JFP)

25828 SIDEWISE DISPERSION CALCULATIONS FOR LEPTON MAGNETIC MOMENT IN RENORMALIZABLE WEAK INTERACTION MODELS. Sasaki, R. (Tokyo Univ.); Fukuda, R. Nucl. Phys.; B59: No. 2, 557-569(1973).

The sidewise dispersion calculations are presented for the lepton magnetic moment in Weinberg's type of weak interaction model, in the U-gauge formalism. Unsubtracted sidewise dispersion relations hold, but as for the W and Z boson contributions, the results are different from those obtained by the ξ-limiting procedure. The differences are attributed to the non-commutativity of the dispersion integration and the $\xi \rightarrow 0$ limit. (auth)

25829 ω PHOTOPRODUCTION AND PION EXCHANGE. Sundaram, A. (Tokyo Inst. of Tech.). Lett. Nuovo Cim.; 7: No. 17, 885-890(25 Aug 1973).

The process $\gamma + p \rightarrow \omega + p$ is studied at 2.8 to 9.3 GeV taking into account p, f, A_2, and π trajectories without invoking ad hoc parameters. The pion is treated according to Gotsman and Maor to see whether this procedure yields a good description of the unnatural-parity contribution to this process. The natural-parity exchange contribution is described in the dual absorptive model through the vector-dominance model to get a parameter-free fit to the studied process. The differential cross sections, natural-parity exchange contributions to the differential cross sections, and the predictions for parity asymmetry are found. (JFP)

25830 POSSIBLE PARTONIC CONTENT OF VIRTUAL PHOTONS. Knoth, A. (Universidade Federal do Rio de Janeiro, Guanabara, Brazil). Lett. Nuovo Cim.; 7: No. 16, 813-814(18 Aug 1973).

Two views are given on a possible partonic content of virtual photons for examining the effective interaction range of the virtual photon in deep inelastic electron-proton scattering. The first considers that the virtual photon interacts with the partonic clusters of the baryonic target by converting into a parton-antiparton pair (or clusters in the case of the parton cluster model), which forms a bound state (e.g., the ρ^0 meson) which interacts with the baryon. The second possibility is to consider the virtual photon itself as an extremely tightly bound parton-antiparton system, which in the presence of the potential due to the partonic clusters of the baryon becomes partially decoupled. (LBS)

25831 VECTOR MESONS AND THE TENSOR CURRENT DIVERGENCE PRINCIPLE. Amarante, J. A. A. (California Inst. of Tech., Pasadena). Nuovo Cim.; 17A: No. 1, 215-231 (1 Sep 1973).

A model of quarks interacting with phenomenological vector mesons is proposed. Using the vanishing of the renormalization constants as a compositeness criterion for these mesons, a relation which substitutes the old hypothesis of the partial conservation of the tensor current (PCTC) is derived and resolves all its difficulties. It is called the tensor current divergence principle (TCDP) since it relates the divergence of the tensor generator of U_{12} with the difference between the vector current and the weighted source of vector mesons. Exact universality of the vector-meson "electric" form factors at $q^2 = 0$ is predicted. Very interesting relations are obtained for the "magnetic" form factors. Good agreement with experiment is obtained for the case where data are available. A consistent physical interpretation is then achieved for the only operator of U_{12}, its tensor current generator, still lacking a physical meaning. (auth)

25832 SEMI-CLASSICAL DERIVATION OF THE ANOMALOUS MAGNETIC MOMENT OF THE ELECTRON. Bourret, R. (Observatoire de Paris, Meudon, France). Lett. Nuovo Cim.; 7: No. 16, 801-805(18 Aug 1973).

Stochastic perturbation techniques are used to derive the anomalous magnetic moment of the electron. The formalism of quantum electrodynamics is obviated by working with a random radiation field appearing directly in the Heisenberg equations of motion of a dynamical system. (LBS)

25833 PHENOMENOLOGICAL APPROACH TO DUAL RESONANCE MODELS FOR DEEP INELASTIC ELECTROPRODUCTION. Rothe, K. D. (Univ., Heidelberg). Z. Phys.; 262: No. 1, 71-82(1973).

A systematic procedure is outlined for constructing a dual resonance model for deep inelastic electroproduction which incorporates locality, current algebra, Regge behavior, Bjorken scaling and the Dashen–Fubini–Gell-Mann sum rule. The procedure is illustrated in terms of a simple Ansatz for the W_2 electroproduction structure function. (GE)

25834 ELECTROMAGNETISM AS AN INERTIAL FORCE. Ingraham, R. L. (New Mexico State Univ., Las Cruces). Lett. Nuovo Cim.; 7: No. 16, 846-850(18 Aug 1973).

It is shown that electromagnetism as well as gravitation can be described as an inertial force provided that the trajectory of a test particle of any charge q and mass m, subject only to gravitational and electromagnetic forces, is universal—independent of q and m—and invariably defined in a basis geometry for space-time. (LBS)

25835 LIGHT CONE ALGEBRA OF A SELF-INTERACTING QUARK FIELD. Bigi, I. I.; Duerr, H. P.; Winter, N. J. (Max-Planck-Institut fuer Physik und Astrophysik, Munich). Phys. Lett.; 45B: No. 4, 384-388(6 Aug 1973).

In a gauge invariant model for a self-interacting constituent quark field of subcanonical dimension $\frac{1}{2}$ the current operators and the energy-momentum operator are explicitly constructed. The current-current commutator near the light cone is found to be distinctly different from the free quark case with corresponding implications on deep inelastic lepton-hadron scattering. (auth)

25836 TRANSITION MAGNETIC MOMENTS OF HADRONS AND SIDEWISE DISPERSION RELATIONS. Bluvstein, R. E.; Dubovik, V. M. (Joint Inst. for Nuclear Research, Dubna). Phys. Lett.; 45B: No. 4, 345-348(6 Aug 1973).

Systems of linear relations for the magnetic moments of the nucleon and transition moments $\mu_{\omega N\gamma}$, $\mu_{\rho N\gamma}$ and $\mu N^*_{1470} N\gamma$ are obtained on the basis of sidewise dispersion relations in the one-pion approximation. In such an approach the magnetic moments of the transition $\omega(\rho) \rightarrow \pi\gamma$ and $N^*_{1470} \rightarrow N\gamma$ are expressed in terms of the anomalous magnetic moments of the nucleon and the strong interaction coupling constants. (auth)

25837 EFFECTS OF NEUTRAL WEAK CURRENTS IN ANNIHILATION. Budny, R. (Oxford Univ.). Phys. Lett.; 45B: No. 4, 340-344(6 Aug 1973).

General cross sections are given for annihilation via one photon and W^0 exchange. Effects of the W^0 in the special cases $e^+e^- \rightarrow \mu^+\mu^-$ and $\bar{p}p \rightarrow l^+l^-$ at high energies are discussed. These effects

are estimated to be comparable to the effects from one γ exchange at energies accessible in NAL and SPS. (auth)

25838 VENEZIANO-TYPE REPRESENTATIONS FOR THE FORM FACTORS AND THE COUPLINGS OF HEAVY VECTOR MESONS. Akcay, H. (Middle East Tech. Univ., Ankara). Nuovo Cim.; 17A: No. 1, 96-102(1 Sep 1973).

A Veneziano-type formula for the pion electromagnetic form factor is reexamined, in light of new experimental information. It is found that a simultaneous fit to the asymptotic behavior and to the couplings of photons to vector mesons is possible if only the even-daughter vector poles are allowed to couple to the photon. The couplings of vector mesons to the nucleon are discussed with a similar assumption for the isovector Dirac form factor. A universal coupling for the vector meson is observed. (auth)

25839 MUON MASS. Tangherlini, F. R. (Coll. of the Holy Cross, Worcester, MA). Nuovo Cim.; 17A: No. 1, 66-72(1 Sep 1973).

Some recent mass formulas by the author yield a value for the muon mass of about 105.652 MeV, or about 70 ppM lower than the present value obtained by the magnetic moment plus g-factor method. An examination is given of energy transition data such as the pion-muon mass difference and x-ray transitions in muonic atoms, and the results favor the lower value indicated by the mass formulas but with a large uncertainty. (auth)

25840 NEW SUM RULE FOR PHOTOPRODUCTION AMPLITUDES BASED ON LOCAL CURRENT COMMUTATORS. Goldberg, H. (Department of Physics, Northeastern University, Boston, Massachusetts, 02115). Phys. Rev. Lett. 30: No. 15, 722-726 (9 Apr 1973).

A sum rule for isovector Compton scattering, previously derived using dispersive techniques, is rederived using the $++$ light-cone commutator. The (nontrivial) limit of the sum rule at $q^2=0$ is given, and is found to be in excellent agreement with experiment. The deep-inelastic limit of the sum rule is discussed in the context of the covariant parton model, where it is shown that the free-field realization is untenable. (auth)

25841 SPECULATIONS ON THE BREAKDOWN OF SCALING AT 10^{-15} CM. Chanowitz, M. S.; Drell, S. D. (Stanford Linear Accelerator Center, Stanford University, Stanford, California, 94305). Phys. Rev. Lett. 30: No. 17, 807-810 (23 Apr 1973).

Hints from existing data suggest that deviations from scaling behavior should appear at momenta $|q^2| \geq 20$ GeV^2. We interpret the deviations as due to structure of the hadronic constituents at 10^{-15} cm and make experimental predictions. (auth)

25842 MASS RENORMALIZATION OF A VECTOR MESON. Chiang, C. C.; Chiu, C. B. (Univ. of Texas, Austin). Nuovo Cim.; 16A: No. 3, 511-521(1 Aug 1973).

Results are presented on the mass renormalization of a vector meson within the framework of shadow-state theory based on the techniques of the Feynman diagram, the unitarity and dispersion relations. The analytic result obtained from the conventional renormalization prescription and the piecewise analytic result from the shadow-state theory are contrasted. (auth)

25843 INVARIANT AMPLITUDES FOR COMPTON SCATTERING OF OFF SHELL PHOTONS ON POLARIZED NUCLEONS. Perrottet, M. (CNRS, Marseille). Lett. Nuovo Cim.; 7: No. 17, 915-921(25 Aug 1973).

A set of 18 invariant amplitudes are described free from kinematical singularities in ν and t, where ν is proportional to the incoming-photon energy in the Breit frame and t is the squared momentum transfer, for Compton scattering of off-shell photons on polarized nucleons. Special cases related to the forward and nonforward scattering limits are discussed. (JFP)

25844 PHOTOPRODUCTION PROCESSES $\gamma N \to \pi N, \eta N, K\Lambda, K\Sigma$ IN A DUAL MODEL WITH FIXED POLES. Bender, I. (Univ., Heidelberg); Koerner, J. G.; Schmidt, M. G.; Linke, V. Nuovo Cim.; 16A: No. 3, 377-410(1 Aug 1973).

The photoproduction of pseudoscalar mesons is investigated in the framework of a dual B_5-model with fixed and Regge poles. A reasonable fit to the available high-energy forward scattering data is presented which is characterized by essentially three parameters. The values of the Regge residues for natural- and unnatural-parity exchanges agree with the values obtained in other photoproduction models. The photoexcitation features of the low-lying baryon resonances derived from our model are in qualitative agreement with experimental results. (auth)

25845 ONE-PION-EXCHANGE-CURRENT CONTRIBUTION TO NEUTRON-PROTON BREMSSTRAHLUNG. Thompson, R. H.; Heller, L. (Los Alamos Scientific Laboratory, University of California, Los Alamos New Mexico 87544). Phys. Rev. C 7: No. 6, 2355-2365 (June 1973).

The electromagnetic current $\vec{j}_2^{OPE}$ due to the exchange of a charged pion between a neutron and a proton is rederived by comparing the bremsstrahlung matrix element computed from the Schrödinger equation with that obtained from the lowest-order Feynman diagrams. No account is taken of renormalization effects or nucleon resonances. The operator $\int d^3x \vec{j}_2^{OPE}(\vec{x}) e^{-i\vec{k}\cdot\vec{x}}$ which is needed for neutron-proton bremsstrahlung calculations is evaluated, and an approximation to it is obtained as an expansion in powers of (photon energy)/(pion mass), keeping the first two terms. This is expected to be considerably more accurate than expanding the bremsstrahlung matrix element itself in powers of k. The second term in the expansion contributes to $^1S_0 \leftrightarrow {}^3S_1$ transitions and may become significant even for small values of k/μ. As a preparation for actual calculations the operator is rewritten in terms of irreducible tensors. The treatment of nonlocalities other than charged-pion exchange is discussed briefly. (auth)

25846 COMMENTS ON THE DERIVATION OF THE COVARIANT FEYNMAN RULES IN THE GAUGE THEORIES. Li, L. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). Phys. Rev. D 7: No. 12, 3815-3817 (15 June 1973).

It is pointed out that Weinberg's derivation of the covariant Feynman rules in the canonical formalism contains two errors in handling the fermions, and, in fact, these two errors cancel each other. (auth)

25847 GAUGE MODEL OF WEAK AND ELECTROMAGNETIC INTERACTIONS WITH NO NEUTRAL CURRENTS OR HEAVY LEPTONS. Chang, N.; Ma, E. (Department of Physics, City College of the City University of New York, New York, New York, 10031.). Phys. Rev. D 7: No. 12, 3808-3811 (15 June 1973).

A gauge-invariant model in which the only gauge particles are the photon and the W boson is constructed without the introduction of heavy leptons. The resulting Lagrangian is nonpolynomial; the question of its renormalizability is discussed. (auth)

25848 HADRONIC FINAL STATES OF DEEP-INELASTIC PROCESSES IN SIMPLE QUARK-PARTON MODELS. Kogut, J.; Sinclair, D. K. (Institute for Advanced Study, Princeton, New Jersey 08540); Susskind, L. Phys. Rev. D 7: No. 12, 3637-3657 (15 June 1973).

Bjorken and Feynman have suggested a quark-parton-model approach to predicting the final-state hadron spectra in deep-inelastic processes. Since the final-state interaction in their approach is characterized by short-range correlations in rapidity, it is natural to ask whether parton models with final-state interactions based on conventional multiperipheral dynamics might provide realizations of their picture. This is found to be untrue. We argue by studying perturbation-theory models (ϕ^3 and cutoff vector-gluon ladder models) and by formulating a rather general intuitive space-time argument that in naive parton models of this type one cannot avoid the appearance of isolated-quark quantum numbers in the final state. In the $\lambda\phi^3$ models the final-state interaction always vanishes in the deep-inelastic region (as well as in the high-energy annihilation region) regardless of the size of λ. In the vector-gluon model, the final-state interaction does not vanish asymptotically, but the struck quark parton cannot exchange its charge with the target fragments. The character of parton dynamics necessary to realize the Bjorken-Feynman picture is discussed. (auth)

25849 CALCULATION OF THE N-P MASS DIFFERENCE IN MODELS BASED ON THE ISOSPIN GAUGE GROUP. Pi, S. (Institute for Theoretical Physics, State University of New York at Stony Brook, Stony Brook, New York 11790). Phys. Rev. D 7: No. 12, 3750-3754 (15 June 1973).

The sign of $\Delta m|_{n-p}$ is found to be negative in three models based on the isospin gauge invariance. (auth)

25850 MAGNETIC DIPOLE AND ELECTRIC QUADRUPOLE MOMENTS OF THE W$^\pm$ MESON. Kim, K. J.; Tsai, Y. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). Phys. Rev. D 7: No. 12, 3710-3721 (15 June 1973).

It is shown that the magnetic dipole and the electric quadrupole moments of the W$^\pm$ meson must be equal to e/m and $-e/m^2$, respectively, if we demand either that the Drell-Hearn sum rule is satisfied up to order α^2 or that the helicity of W$^\pm$ is conserved in the scattering from an arbitrary electromagnetic field at high energies and at small but finite scattering angles. (auth)

25851 THREE-TRIPLET REALIZATIONS OF GAUGE MODELS AND ELECTROMAGNETIC MASS DIFFERENCES. Love, A.; Ross, G. G. (Rutherford High Energy Laboratory, Chilton, Didcot, Berkshire, England). Phys. Rev. D 7: No. 12, 3812-3815 (15 June 1973).

We construct three-triplet realizations of the gauge models for weak and electromagnetic interactions based on the groups O(3) and SU(2) $\otimes$ U(1). Within the framework of these models we find that the logarithmically divergent contributions to "electromagnetic" mass differences arising from the exchange of the gauge particles may be made to cancel. (auth)

25852 BREMSSTRAHLUNG MODEL AND SCALING IN ELECTROPRODUCTION: A SECOND LOOK. Islam, M. M.; Owens, J. R. JR (Department of Physics, University of Connecticut, Storrs, Connecticut 06268). Phys. Rev. D 7: No. 12, 3784-3798 (15 June 1973).

Deep-inelastic electron-proton scattering is investigated in the bremsstrahlung model. In this model a high-energy nucleon emits massive neutral vector mesons when it interacts with the electron. In the electron rest frame where the proton momentum tends to infinity, the mesons are considered soft and an eikonal approximation is made for the nucleon propagator. This leads to a coordinate-space description similar to the elastic-scattering case. The leading light-cone singularity emerging from this description is precisely of the type assumed for Bjorken scaling and arises from the propagation of the final proton. The kinematic region found relevant corresponds to q_z finite and $S_{ep} \simeq 2P{\cdot}p$. Radiative corrections due to soft mesons when included preserve scaling. None of these results were obtained in previous studies of the bremsstrahlung model using different calculational techniques. (auth)

25853 LEPTON PAIR PRODUCTION FROM TWO-PHOTON PROCESSES. Chen, M.; Muzinich, I. J. (Brookhaven National Laboratory, Upton, New York 11973); Terazawa, H.; Cheng, T. P. Phys. Rev. D 7: No. 11, 3485-3502 (1 June 1973).

An exact expression for the lepton-pair mass spectrum for an α^4 two-photon process in lepton-lepton, lepton-hadron, and hadron-hadron scattering processes is derived. This result is applied to muon pair production in proton-proton scattering to show that such a process is an important background to the α^4 one-photon process in certain energy ranges and can become physically significant by itself at very high energies. The general physical significance of such a two-photon process in hadron-hadron scattering is discussed, and comparison of our exact expression with some approximation schemes is made. The main differences between this work and earlier papers on the subject are that (1) exact calculations are given and (2) the inelastic contributions are included. (auth)

25854 DIFFRACTIVE LEPTON-HADRON SCATTERING. Nieh, H. T. (Institute for Theoretical Physics, State University of New York at Stony Brook, Stony Brook, New York 11790). Phys. Rev. D 7: No. 11, 3401-3409 (1 June 1973).

It is emphasized that the photon-dissociation mechanism, according to the present data in the large-ω region, may be the dominant mechanism at large ω. The physical characteristics of the lepton-hadron scattering at large ω may therefore be quite different from those at small ω. By identifying incoherence as the main physical reason for the scaling observed in the small-ω region, we conclude that there is no basis for expecting scaling in the large-ω region. Scaling may still hold there, but a breakdown of scaling should not be surprising. Speculations along this line are ventured. (auth)

25855 THEORY OF TRANSITION RADIATION IN A NON-STATIONARY MEDIUM. Ginzburg, V. L.; Tsytovich, V. N. (Lebedev Inst. of Physics, Moscow). Zh. Eksp. Teor. Fiz.; 65: No. 1, 182-144 (Jul 1973). (In Russian).

A theory of transition radiation in a medium with a time-varying refractive index (which is assumed to vary in a step-like manner) is developed. Along with the radiation field and energy (including the relativistic case) calculations are performed for the work of radiative friction on the emitting particle and also for the change in energy of the field which the particle drags. (auth)

25856 ELECTRON IN A QUANTIZED PLANE WAVE AND IN A CONSTANT MAGNETIC FIELD. Fedorov, M. V.; Kazakov, A. E. (Lebedev Inst. of Physics, Moscow). Z. Phys.; 261: No. 3, 191-202 (1973).

The Dirac equation is considered for an electron in a constant homogeneous magnetic field and in a quantized electromagnetic plane wave propagating along the direction of the former. This problem is shown to be reduced to the Schroedinger equation for a system of many interacting oscillators. The corresponding Hamiltonian is diagonalized. An equation is established relating the total energy with the moment of a system along the magnetic field. Approximate solutions of this equation are given. A behavior of a system close to cyclotron resonance is discussed. (GE)

25857 GRIBOV-LIPATOV RECIPROCITY FROM CONSERVATION CONSTRAINTS AND O(4) SYMMETRY. Etim, E. (CNEN, Frascati, Italy). Phys. Lett.; 45B: No. 5, 478-480 (20 Aug 1973).

The physical basis of the Gribov-Lipatov reciprocity is traced to energy-momentum conservation, N-plane analyticity and O(4) symmetry. (auth)

Weak

Refer also to abstract 25996.

25858 (DNPL/R-28) AN INTRODUCTION TO LIGHT-CONE COMMUTATORS AND SUM RULES. Daresbury Lecture Note Series No. 11. Paver, N. (Daresbury Nuclear Physics Lab. England)). 1972. 21p. Dep. NTIS (U. S. Sales Only) $3.25.

The derivation of asymptotic and fixed mass sum rules using the light cone approach is described. The emphasis is put on the general features and the basic physical ideas of the method rather than the specific results. (UK)

25859 (IFA-FT-94) SIMPLE BOUND FOR K_{13} DECAY PARAMETERS USING THE K(S = 0, T = ½) PHASE SHIFT. Micu, M.; Radescu, E. (Institutul de Fizica Atomica, Bucharest (Romania)). Mar 1972. 6p. INIS.

Taking as known the value of the propagator of the divergence of the weak strangeness changing vector current at zero momentum transfer (t = 0) and the phase of the divergence K_{13} form factor d(t) in the elastic region (where it is given by the phase of the s = 0, T = ½ K scattering), one finds a simple bound for d' (t = 0) which gives a stronger restriction on the K_{13} parameters than the one originally obtained by Li and Pagels. (auth)

25860 (ITEF-877) WEAK INTERACTIONS OF COLLIDING LEPTON BEAMS WITH ENERGY ($10^2 - 10^3$) GeV. Dolgov, A. D, Okun, L. B.; Zakharov, V. I. (Gosudarstvennyi Komitet po Ispol' Zovaniyu Atomnoi Energii SSSR, Moscow. Institut Teoreticheskoi i Eksperimental'noi Fiziki). 1971. 24p. INIS.

Weak V-A interaction of colliding lepton beams at high energies is considered. It is assumed that weak coupling constant G is the only parameter inherent to weak leptonic interaction so that terms of higher order become appreciable at total energy $2E = S^{-\frac{1}{4}}$ of order $G^{\frac{1}{4}}$. It is shown that for colliding lepton-antilepton beams 2×250 GeV the contribution of weak interactions to the differential cross section of elastic scattering at 90° prevails over that of electromagnetic interaction. The estimate of the weak cross section is based on the calculation of the imaginary part of the amplitude, which is uniquely determined in the second order in G. Phenomenological description of the real part of the amplitude in the same approximation introduces a single unknown parameter. Provided the validity of dispersion relations with two subtractions is granted this parameter is related to the integral of total cross sections of ll and ll^- weak interactions. Terms of the third order in G are studied in a similar way and estimation of the magnitude of these terms is given. (auth)

25861 (RL-73-42) SCALE DIMENSION OF THE CHIRAL-SYMMETRY-BREAKING HAMILTONIAN. Fayyazuddin; Riazuddin. (Rutherford High Energy Lab., Chilton (England)). Jun 1973. 8p. Dep. NTIS (U. S. Sales Only) $3.00.

Arguments are presented based on positivity conditions and light cone analysis for the structure functions W_4 and W_5 (which occur in neutrino scattering) to conclude that if they scale as $\nu^p W_{4,5}(\nu, q^2) - F_{4,5}(\xi)$ then p = 2. The following bound is obtained on the scale dimension l_u of the chiral symmetry breaking Hamiltonian: $-\frac{5}{2} \geq l_u > -4$. Further, if it is assumed that fractional dimensions are not admissible, $l_u = -3$ is obtained. (auth)

25862 REMARKS CONCERNING THE RENORMALIZED COUPLING CONSTANTS OF THE GAUGE THEORIES. Bollini, C. G. (Univ. Nacional, La Plata); Giambiagi, J. J.; Sirlin, A. Nuovo Cim.; 16A: No. 3, 423-436 (1 Aug 1973).

Some basic properties of renormalized coupling constants are discussed in the framework of spontaneously broken gauge symmetries. It is pointed out that conventional definitions lead to some difficulties connected with infra-red divergences and two possible solutions are suggested. The ultraviolet divergent contributions to the lowest-order corrections are then studied and it is shown explicitly, in a number of particular examples, how these divergent terms cancel in the interrelations between renormalized coupling constants and masses. The specific calculations are carried out in the unitary gauge of the $SU_2 \times U_1$ gauge model, using the ν-dimensional regularization method. (auth)

25863 NEUTRINO EXCHANGE AND ASYMPTOTIC BEHAVIOR OF WEAK INTERACTION CROSS SECTIONS. Dolgov, A. D.; Gribov, V. N.; Okun, L. B.; Zakharov, V. I. (Inst. for Theoretical and Experimental Physics, Moscow). Nucl. Phys.; B59: No. 2, 611-628 (1973).

It is argued that total cross sections cannot increase asymptotically as a power of energy even in the presence of massless particle exchange. Elastic $\nu\nu$ scattering is considered as an example. The properties of s- and t-channel partial waves are analyzed and it is shown that the above statement is true if the amplitude is bounded by a polynomial in s for $s \to \infty$ and $t > 0$ and if its singularity at t = 0 is dominated by two-particle exchange. (auth)

25864 SEMI-LEPTONIC DECAYS IN THE MODEL OF BARS, HALPERN, AND YOSHIMURA. Collins, J. C. (Univ. of Cambridge, Eng.). Nucl. Phys.; B59: No. 2, 545-556 (1973).

Semi-leptonic decays are investigated in the gauge theory of Bars, Halpern and Yoshimura, using elementary baryons rather than quarks. It is proved that in order to get a correct d/f ratio in these decays it is necessary to use an (8,8) spin-zero hadron field, together with another multiplet of spin-zero hadrons. The tree approximation is shown not to be sufficient to calculate the decay amplitudes correctly. (auth)

25865 UNIFIED APPROACH TO RESONANCES AND PARTONS AS A REPRESENTATION OF THE FRITZSCH–GELL-MANN BILOCAL ALGEBRA AT INFINITE MOMENTUM. Pavkovic, M. I. (New York Univ., NY). Lett. Nuovo Cim.; 7: No. 17, 931-935 (25 Aug 1973).

It is shown that the recently developed unified approach to resonances and partons furnishes a nontrivial and physically interesting representation of the Fritzsch–Gell-Mann bilocal algebra. A quark model representation is used. Deep inelastic lepton–nucleon scattering is considered. (JFP)

25866 DEPENDENCE OF THE ASYMMETRY OF NEGATIVE MUON DECAY ELECTRONS ON THE LENGTH OF THE HYDROCARBON CHAIN OF ALCOHOLS AND ALKYL CHLORIDES. Dzhuraev, A. A.; Evseev, V. S.; Obukhov, Yu. V.; Roganov, V. S.; Obukhov, Yu. V.; Roganov, V. S.; Frontas'eva, M. V.; Kholodov, N. I. (Joint Inst. for Nuclear Research, Dubna, USSR). Zh. Eksp. Teor. Fiz.; 64: No. 6, 1930-1934(Jun 1973). (In Russian).

Relative (with respect to graphite) values of the asymmetry coefficients a/a_C for the angular distribution of $\mu^- \rightarrow e^-$ decay electrons from muons stopped in aliphatic alcohols $C_nH_{2n+1}OH$ and in chlorine-substituted paraffins $C_nH_{2n+1}Cl$ with various amounts of carbon atoms in the chain are obtained by the method of muon spin precession in a weak transverse magnetic field. With growth of n_C the ratio a/a_C passes through a maximum and then approaches a limit which is determined for paraffin and polyethylene. The dependence derived is interpreted on the basis of concepts of the chemical interactions of mesic atoms leading to the formation of diamagnetic compounds and of concepts regarding energy migration along the carbon atom chain. (auth)

25867 STRONGLY INTERACTING WEAK INTERMEDIATE BOSONS. Terazawa, H. (The Rockefeller University, New York, New York 10021). Phys. Rev. D 7: No. 12, 3663-3669 (15 June 1973).

We reexamine the weak interaction mediated by the intermediate vector bosons which are assumed to couple to other (probably unknown) particles (or to themselves) more strongly than to the weak currents in order to see whether the theory of this type is potentially free from the divergence difficulty. Sum rules and high- and low-energy limits of the cross sections are obtained for various weak-interaction processes. (auth)

25868 KINEMATICS AND DYNAMICS OF K_{l3} FORM FACTORS. Fischbach, E.; Nieto, M. M. (Physics Department, Purdue University, Lafayette, Indiana 47907); Scott, C. K. Phys. Rev. D 7: No. 11, 3544-3545 (1 June 1973).

We discuss how the question of a zero at $t = (m_K + m_\pi)^2$ in the Duffin–Kemmer–Petiau K_{l3} divergence matrix element [the effective form factor $\hat{f}_0(t)$] is a combined question of kinematics and dynamics. (auth)

25869 KINEMATICS OF K_{l3} DECAY AMPLITUDES AND RELATIVISTIC EQUATIONS FOR SPIN-0 PARTICLES. Willey, R. S.; Winternitz, P.; Yao, T. (Department of Physics, University of Pittsburgh, Pittsburgh, Pennsylvania 15213). Phys. Rev. D 7: No. 11, 3540-3543 (1 June 1973).

The standard S-matrix kinematic analysis is applied to the K_{l3} decays to show that the form factors $f_\pi(t)$ are free of kinematic singularities or constraints. The general form of the matrix elements of the vector current and its divergence in the Duffin–Kemmer formalism are determined and shown to be consistent with the general kinematic analysis, in contrast to a form proposed in some recent letters. (auth)

25870 K_{l3} AND π_{E3} DECAYS IN TERMS OF THE KEMMER β CURRENT. Aydin, Z. Z.; Barut, A. O. (International Centre for Theoretical Physics, Trieste, Italy.). Phys. Rev. D 7: No. 11, 3522-3525 (1 June 1973).

Energy spectra of leptons and partial decay rates in K_{l3} and π_{e3} decays are evaluated within the framework of single Kemmer currents. Branching ratio of the two K_{l3} decay modes and the π_{e3} decay rate are found to be in agreement with experiment. The formalism brings in mass ratios naturally and hence considerably simplifies the problem. (auth)

25871 CALCULATION OF $K^0_2 \rightarrow \pi^+\pi^-\gamma$ DECAY AS A CONSISTENCY TEST OF A CURRENT–CURRENT QUARK MODEL. Rockmore, R.; Wong, T. F. (Department of Physics, Rutgers, The State University, New Brunswick, New Jersey 08903). Phys. Rev. D 7: No. 11, 3425-3428 (1 June 1973).

The CP-conserving decay $K^0_2 \rightarrow \pi^+\pi^-\gamma$ is studied in a modified fermion–loop model as a consistency test of a current–current quark model. The weak Hamiltonian is phenomenologically constructed from one-baryon octet matrix elements. The predicted branching ratio $r = R(K^0_2 \rightarrow \pi^+\pi^-\gamma)/R(K^0_2 \rightarrow \text{all modes}) = 3.0 \times 10^{-4}$ is below the present experimental upper limits of Thatcher et al. ($r < 4 \times 10^{-4}$) and may be compared with the tree-graph estimate $2.6 \times 10^{-4} < r < 4 \times 10^{-4}$ of Moshe and Singer; however, the present model has no adjustable parameters. (auth)

25872 WHAT POSITIVITY TELLS US ABOUT PARTON-MODEL SUM RULES. Nachtmann, O. (Institute for Advanced Study, Princeton, New Jersey 08540). Phys. Rev. D 7: No. 11, 3340-3348 (1 June 1973).

The following problem is solved: Given the experimental information on deep-inelastic electron-nucleon scattering from SLAC, what are the best bounds for integrals over neutrino–scattering structure functions in the framework of the quark–parton model? This is used to discuss the saturation of the Adler and Gross–Llewellyn–Smith sum rules and to give predictions for neutrino- and antineutrino–nucleon total cross sections. (auth)

25873 STRUCTURE EFFECTS OF THE DECAYS $K_{L,S} \rightarrow \gamma +$ DALITZ PAIR. Sehgal, L. M. (III. Physikalisches Institut, Technische Hochschule, Aachen, Germany). Phys. Rev. D 7: No. 11, 3303-3308 (1 June 1973).

We investigate the form factors associated with the vertices $K_{1,2} \rightarrow \gamma\gamma$ when one of the photons is virtual and their influence on the rate and spectrum of the Dalitz pair reactions $K_{1,2} \rightarrow \gamma + l^+l^-$. We find that while the form factor in $K_2 \rightarrow \gamma\gamma$ produces a small uniform enhancement, that in $K_1 \rightarrow \gamma\gamma$ suppresses the relative probability of lepton pairs of large invariant mass ($\sqrt{t}$), an effect that should be most noticeable in the decay $K_1 \rightarrow \gamma\mu^+\mu^-$ for muon pairs of $t > 4(\text{pion mass})^2$. (auth)

25874 TRITIUM BETA DECAY AND THE NEUTRINO MASS. Law, J. (Department of Physics, University of Guelph, Guelph, Ontario, Canada). Phys. Rev. D 7: No. 11, 3314-3317 (1 June 1973).

A method of analysis is proposed which may provide a better limit for the neutrino mass when analyzing Kurie plots of the beta spectrum from tritium beta decay near the end-point energy. By determining the sign of the second derivative of the Kurie plot, it is possible to place an upper or lower limit to the neutrino mass of about 35 eV. However, the method demands data of sufficient accuracy. (auth)

25875 PRODUCTION OF PIONS BY MEANS OF NEUTRINOS. Schultze, K. (Technische Hochschule, Aachen). Fortschr. Phys.; 19: No. 12, 815-895(1971). (In German).

After separation of elastic and inelastic neutrino reactions, the production of a single pion was studied and the total cross section was determined for inelastic neutrino reactions. An analysis showed that the single pion production could be described as a resonance excitation of the nucleon. (HBG)

Strong (General)

25876 (CONF-730457-1) SPECTROSCOPY OF STRONG INTERACTIONS. Butterworth, I. (Forsvarets Forskningsanstalt, Stockholm (Sweden)). 1973. 38p. Dep. NTIS (U. S. Sales Only) $4.00.

In 1947 Rochester and Butler, studying interactions induced by cosmic rays, obtained a series of fascinating cloud chamber photographs, leading to the discovery of a new, totally unsuspected, set of strongly interacting particles, and to a flood of subsequent discoveries, so that today the number of strongly interacting particles, or hadrons as they are called, is around 300. All except the proton are unstable. Their large number and mutual transitions suggest quantum states of a more basic dynamical system. Progress in understanding the spectroscopy of hadron states is discussed. (auth)

25877 (NP-19841) REGGE PHENOMENOLOGY OF INCLUSIVE REACTIONS. Miettinen, H. I. (Rutherford High Energy Lab., Chilton (England)). May 1973. 92p. Dep. NTIS (U. S. Sales Only) $6.75.

Thesis. Submitted to Univ. of Helsinki.

The inclusive reactions of elementary particles are studied and the suitability of Regge model to describe them is cleared up. The thesis consists of five works published in international periodicals. In three of them it is concentrated upon the experimental testing of a basic assumption of Regge's theory, factorization properties of elementary particles. The analytical data show that the collisions of elementary particles happen in many various stages which clearly differ from each other. In two other publications the spectra of elementary particles produced by the great accelerator (70 GeV) at Serpukov in USSR and the "Intersecting Storage Rings" (1500 GeV) at Cern in Geneva are analyzed. (JPL)

25878 DOUBLE-POMERON DECOUPLING AND THE RELATION OF EXCLUSIVE TO INCLUSIVE EXPERIMENTS WITH THE

DUAL RESONANCE MODEL. Mehta, C. H. (Univ. of California, San Diego, La Jolla); Silverman, D. Nucl. Phys.; B59: No. 2, 460-476 (1973).

The double-pomeron coupling strength in the dual resonance model is found in both the inclusive and exclusive regions by comparison with experiments. Double-pomeron coupling occurs in inclusive experiments in the Mueller diagram for the central plateau region. Its strength can also be bounded from its non-observation in the two-particle to four-particle exclusive experiments. The dual resonance model is used to perform the analytic continuation of a six-point amplitude between these regions. The results show that the coupling strength for two forward pomerons in the exclusive region must be less than $1/300$ of that in the inclusive region. This is experimental evidence for substantial forward double-pomeron decoupling in exclusive processes. (auth)

25879 DIFFRACTIVE DISSOCIATION AND HADRON STRUCTURE. Lubatti, H. J.; Moriyasu, K. (Univ. of Washington, Seattle). Nucl. Phys.; B59: No. 2, 525-544(1973).

A model of hadronic interactions is proposed which explains many of the puzzling features of diffractive dissociation. The model is based on an extension of the familiar Harari–Rosner dual quark diagrams. By introducing self-energy corrections to the bare hadron, new classes of dual diagrams are obtained. Some of these diagrams can be identified with diffractive dissociation and they provide simple explanations of the experimental features of diffractive processes. The new diagrams are compatible with the usual multiperipheral approach and give new insight into the Deck model and general multiparticle production. (auth)

25880 RELATIVISTIC MODELS OF COMPOSITE HADRONS: A GROUP THEORETICAL APPROACH. Ramond, P. (Yale Univ., New Haven). Nucl. Phys.; B59: No. 2, 412-428(1973).

Following Guersey and Orfanidis, a general group theoretical framework with which to build the generators of the Poincaré group for the description of a relativistic composite hadron in the zero-width approximation is presented. By insisting that the composite hadron be made up of an infinite number of point-like constituents (partons), it is found necessary to introduce new degrees of freedom to achieve relativistic invariance. Several ways to do this are presented. (auth)

25881 PHENOMENOLOGICAL FIELDS AND HIGH ENERGY REACTIONS. Stuller, R. L. (Max-Planck-Institut fuer Physik und Astrophysik, Munich). Nuovo Cim.; 17A: No. 1, 37-47(1 Sep 1973).

It is suggested that phenomenological field theory can be useful for the description of high-multiplicity reactions. A simple example shows that the "fireball model" of strong interactions exhibits the structure of a generalized free field. (auth)

25882 CURRENT QUARK CONTENT OF HADRONS. Savoy, C. A. (Univ., Geneva). Lett. Nuovo Cim.; 7: No. 16, 841-845 (18 Aug 1973).

A simple model for hadrons as made of quarks is considered in the light of the Melosh transformation. The quark current content of mesons is found to be uniquely determined. Some arbitrariness was found in the case of baryons. It is suggested that this arbitrariness could be avoided either by imposing further conditions on the charge matrix elements or by choosing a definite spectrum like the one in the harmonic-oscillator quark model. (LBS)

25883 MULTIPLICITY DISTRIBUTION IN THE STRING MODEL OF HADRONS. Yabuki, H. (Kyoto Univ.). Lett. Nuovo Cim.; 7: No. 16, 797-800(18 Aug 1973).

The multiplicity distribution (n-dependence of $\sigma_n(s)\sigma_{tot}(s)$) of high-energy collisions in the string model is discussed. A simple picture for the break-up of hadrons is presented, and its implications are discussed. (LBS)

25884 PION DECAY CONSTANT AS A SCALE FOR HADRON DYNAMICS. Pagels, H. (Rockefeller Univ., New York). Nuovo Cim.; 17A: No. 1, 1-6(1 Sep 1973).

Speculations are made on the implications of the ground-state meson decay constant $f_\pi \simeq 93$ MeV setting the scale for hadron dynamics. On this basis it is conjectured that the asymptotic cross sections obey $\sigma_{\pi N}/\sigma_{KN} = f_K/f_\pi$ in agreement with experiment. It is also found $\sigma_{\pi\pi} = \pi/12f_\pi^2 \simeq 14$ mb so that the pion decay constant scales the asymptotic cross section. (auth)

25885 FEYNMAN DIAGRAM APPROACH TO DUAL-PARTON MODEL. 1. Complication Due to Parton's Isospin. Kanki, T. (Osaka Univ., Toyanaka, Japan). Progr. Theor. Phys. (Kyoto); 49: No. 4, 1271-1280(Apr 1973).

A method is given for treating the products of large number of τ-matrices arising in the calculation of dense planar fishnet Feynman diagrams with isospin $1/2$ partons. The final result is similar to Gervais and Sakita's formula for general dual amplitudes and is expressed in terms of the functional integrals. Explicit formulas are given for the external vertex, each for the cases of $I = 1$ and $I = 1/2$ external particles. (auth)

25886 REINTERPRETATION OF THE TWO-DIMENSIONAL INTERNAL SPACE ASSOCIATED WITH DUAL-RESONANCE MODELS. 1. Conformal-Spin Zero Case. Minami, M. (Kyoto Univ.). Progr. Theor. Phys. (Kyoto); 49: No. 4, 1281-1297(Apr 1973).

After a short account of the dynamical variables of the dual-resonance models in terms of the Fourier analysis, it is shown that they are obtainable as boundary values of quantized fields holomorphic in the complex (one-time, one-space) Minkowski space. The algebraic laws governing the internal space are reproduced in the framework of the Lagrangian field theory. In particular, the group formed by the conformal transformations of the unit-disk into itself is reinterpreted as a sector of the conformal group of the two-dimensional Minkowski space-time. (auth)

25887 TOTAL CROSS SECTIONS AND THE REGGE-POLE MODEL. Ganguli, S. N.; Sarma, K. V. L. (Tata Inst. of Fundamental Research, Bombay). Nuovo Cim.; 17A: No. 1, 232-244 (1 Sep 1973).

It is shown that all the available high-energy data on total cross sections can be incorporated within the framework of the SU_3 Regge-pole model. The model consists of the exchange of tensor- and vector-meson nonets in addition to the Pomeranchuk trajectory. Some of the points which emerge from our analysis are: (i) the total cross sections of π^+p, K^+p, pp eventually increase towards their respective asymptotic limits, while those of their counterparts π^-p, K^-p and pp decrease towards their limiting values; and (ii) the ratios Re/Im of the forward amplitudes are in general predicted to be large in magnitude compared to the available data. (auth)

25888 CONDITIONAL CHARGE DISTRIBUTIONS AT VERY HIGH ENERGIES. Berceanu, S.; Besliu, T.; Cheorghe, A.; Mihul, A. L. M. (Joint Inst. for Nuclear Research, Dubna, USSR). Phys. Lett.; 45B: No. 4, 371-375(6 Aug 1973).

It is shown that the conditional charge distributions in hadronic collisions approach a zero limiting value in the central region at asymptotic energies, provided the average total multiplicities are unbounded. A limiting charge sum rule, which shows how these distributions follow the initial charges, is established and discussed. (auth)

25889 SELF-CONSISTENT POMERON DYNAMICS WITHOUT DECOUPLING. Neff, T. L. (Univ. of California, Berkeley). Phys. Lett.; 45B: No. 4, 349-352(6 Aug 1973).

More conservative conditions on the independently uniform convergence of multi-Regge asymptotic expansions lead to a consistent Pomeron pole dynamics, without requiring the coupling $\Gamma(0,0,0)$ of three such poles to vanish. The onset of large mass diffractive processes at high energies results in an asymptotically constant renormalization of the pole residue. This threshold mechanism may be responsible for the rise in σ_{total} and σ_{el} at ISR and for building the forward quasi-elastic peak in the leading proton x-distribution. (auth)

25890 REVERSE MULTI-REGGE BOOTSTRAP. Bardeen, W. A.; Peccei, R. D. (Stanford Univ., CA). Phys. Lett.; 45B: No. 4, 353-356(6 Aug 1973).

An integral equation for the generating function of partial cross sections is derived in the context of a factorizable Regge–Mueller model of inclusive reactions. With suitable approximations it is shown how the work can reproduce the results of the Chew–Pignotti model and of the recent model of Lee. This latter model is discussed on the basis of our more general viewpoint. A reverse bootstrap is formulated in which the input Regge singularities are the ones that enter in the total cross section and the output singularities are the ones that appear in the partial cross sections. (auth)

25891 TWO-PARTICLE CORRELATION LENGTH IN FIRE BALL MODELS. Bialas, A. (Jagellonian Univ., Krakow); Fialkowski, K.; Zalewski, K. Phys. Lett.; 45B: No. 4, 337-339(6 Aug 1973).

It is pointed out that all models in which particle production occurs via an intermediate step of isotropically decaying fireballs, predict the existence of the positive short-range component in two-particle inclusive correlations. The correlation length is predicted to be about one, in agreement with existing data. (auth)

25892 MISSING GAUGE CONDITIONS FOR THE DUAL FERMION EMISSION VERTEX AND THEIR CONSEQUENCES. Brink, L.; Olive, D.; Rebbi, C.; Scherk, J. (CERN, Geneva). Phys. Lett.; 45B: No. 4, 379-383(6 Aug 1973).

It is found that the dual vertex for emitting a ground state fer-

mion of mass m converts between generalized mesonic G gauges and generalized fermionic F gauges. These generalized gauges consist of infinite linear combinations of F's and G's which are, roughly speaking, square roots of Virasoro gauges and exhibit partial reflection and transmission behavior at the vertex. One of these Ward identities allows the amplitude for fermion re-emission to be reexpressed in the F_2 representation where the limit m = 0 is well defined. It is shown that if m = 0 and d = 10 certain meson channels are saturated by physical (ghost free) states. (auth)

25893 REGGEIZATION OF YANG-MILLS GAUGE MESONS IN THEORIES WITH A SPONTANEOUSLY BROKEN SYMMETRY. Grisaru, M. T.; Schnitzer, H. J.; Tsao, H. (Department of Physics, Brandeis University, Waltham, Massachusetts, 02154). Phys. Rev. Lett. 30: No. 17, 811-814 (23 Apr 1973).

It is argued that the strongly interacting non-Abelian gauge mesons of a renormalizable Lagrangian theory with spontaneously broken vacuum symmetry lie on Regge trajectories. This Lagrangian is of particular interest since it is identical to one found by Gervais and Neveu from the zero-slope limit of a dual-resonance model. The exchange of scalar mesons in vector-vector scattering with coupling constants as given by the Higgs-Kibble mechanism is crucial for our result. (auth)

25894 HOW TO GENERATE THE POMERANCHUKON FROM THE BACKGROUND IN A DUAL MULTIPERIPHERAL MODEL. Lee, H. (Department of Physics, Northeastern University, Boston, Massachusetts, 02115). Phys. Rev. Lett. 30: No. 15, 719-722 (9 Apr 1973).

A dual multiperipheral model is proposed in which duality plays an important role alongside multi-Reggeism and unitarity. Assuming that the Regge trajectories are generated through the resonating contributions, I find that the leading Reggeon has to bootstrap itself. Furthermore, a Pomeranchukon with intercept equal to unity is generated naturally through the background contributions, independent of the strength of the coupling constant. The bootstrapping potential and other interesting results of the model are discussed. (auth)

25895 REGGE TRAJECTORIES IN THE ϕ^3 MULTIPERIPHERAL MODEL WITH STRONG COUPLING. Chang, S. (Institute for Advanced Study, Princeton, New Jersey 08540); Yan, T. Phys. Rev. D 7: No. 12, 3698-3710 (15 June 1973).

The trajectory function α (t) for small t is studied in the ϕ^3 multiperipheral model as the coupling constant becomes very large. Special emphasis is paid to the analogy of the ϕ^3 model to a one-dimensional gas system. We discuss the upper and lower bounds for α (t) when 2,3,... up to the N-body potentials in the gas model are taken into account. The power dependence of α on the coupling constant as well as its dependence on N is determined by our bounds. This power dependence changes as N approaches infinity; it also changes as the mass ratio of the produced final particles to the exchanged particles varies. We show that the equal-spacing approximation suggested by T. D. Lee gives the correct power dependence of α on the coupling constant with a coefficient in error only by a few percent. (auth)

25896 SIMPLE NONADDITIVE DUAL-RESONANCE MODEL. Mandelstam, S. (Department of Physics, University of California, Berkeley, California 94720). Phys. Rev. D 7: No. 12, 3777-3784 (15 June 1973).

A nonadditive model with spin degrees of freedom but no internal symmetry is studied. It is necessary to work in a space of ten or more dimensions in order to obtain a Hermitian Hamiltonian. The model possesses physical-particle creation operators and, rather surprisingly for a nonadditive model, all trajectories are linear. In ten dimensions the model appears to be equivalent to the Neveu-Schwarz model, but the trajectories with half-integral intercept are obtained even though all our operators have integral n. The gauge conditions associated with the L and K algebras are almost certainly sufficient to remove all the ghosts. (auth)

25897 K DEGENERACY IN NONADDITIVE DUAL RESONANCE MODELS. Mandelstam, S. (Department of Physics, University of California, Berkeley, California 94720). Phys. Rev. D 7: No. 12, 3763-3776 (15 June 1973).

The problem of K degeneracy, which has hitherto prevented calculations with nonadditive dual resonance models, is studied. It is shown that the second gauge condition selects out a unique member from each K-degenerate family. The vector so selected is not, in general, normalizable, but finite results can be obtained after renormalization. Calculation of norms and vertex functions is examined and is shown to be perfectly feasible. (auth)

25898 GOLDSTONE BOSONS AS BOUND STATES IN THE QUARK-GLUON MODEL. Pagels, H. (Rockefeller University, New York, New York 10021). Phys. Rev. D 7: No. 12, 3689-3698 (15 June 1973).

We examine the implications of a Nambu-Goldstone realization of chiral symmetry in the quark-gluon model. The context of this examination is that of a renormalizable, finite theory, so eigenvalue conditions are assumed to be satisfied. We discuss the solutions to the Schwinger-Dyson gap equation for the fermion self-energy Σ (p^2) that exhibit spontaneous breaking of the vacuum symmetry. In the leading-order Bethe-Salpeter approximation the boundary conditions to the homogeneous, linear integral equations stipulate the vacuum symmetry. It is shown how the Goldstone bosons emerge as bound states, as suggested by Nambu and Jona-Lasinio. We also examine the Goldstone alternative in the Bethe-Salpeter equation for fermion-fermion scattering. Explicit symmetry breaking is introduced by additional Abelian vector gluons coupling to hypercharge and isospin besides baryon number. The eigenvalue condition for the fine-structure constant is consequently model-dependent but takes a simple form. We also consider the influence of explicit symmetry breaking on the ground-state mesons and indicate how the solutions to the eigenvalue problem regulate the structure of symmetry breaking. (auth)

25899 REGGEON-REGGEON-PARTICLE VERTEX AND FEYNMAN GRAPHS. Patrascioiu, A. (Laboratory for Nuclear Science and Department of Physics, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). Phys. Rev. D 7: No. 12, 3658-3663 (15 June 1973).

The analytic properties of Feynman graphs are used to suggest the singularity structure of the Reggeon-Reggeon-particle vertex. (auth)

25900 CHARGE TRANSFER IN THE MULTIPERIPHERAL MODEL. Snider, D. R. (Department of Physics, University of Wisconsin-Milwaukee, Milwaukee, Wisconsin 53201). Phys. Rev. D 7: No. 11, 3517-3519 (1 June 1973).

Predictions for the charge transferred from one c.m. hemisphere to the other are made based on a multiperipheral model containing I = 0 and 1 exchanges. These predictions differ strongly from those of the fragmentation model. Thus measurements of transferred charge are sensitive tests for these rival models. (auth)

25901 CLARIFICATION OF MULTI-REGGE THEORY. Shankar, R. (Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). Phys. Rev. D 7: No. 11, 3513-3517 (1 June 1973).

We are concerned here with the amplitude for the reaction a + b → 1 + 2 + ...+ N. We assert that the prevalent notion of adding multi-Regge diagrams, corresponding to the different ordering of final particles, has no basis. Arguments supporting this assertion are followed by a list of rules for calculating cross sections. A sample of the literature that motivated this paper is briefly discussed. (auth)

25902 AZIMUTHAL CORRELATIONS AND THE NATURE OF THE POMERANCHUK SINGULARITY IN MODELS WITHOUT SHORT-RANGE ORDER. Sivers, D. (High Energy Physics Division, Argonne National Laboratory, Argonne, Illinois 60439). Phys. Rev. D 7: No. 11, 3332-3339 (1 June 1973).

The existence of long-range azimuthal correlations in inclusive data is known to imply that the Pomeranchuk singularity is not a simple pole. A simple independent-emission model, which shares many properties of multiperipheral models except that the produced particles are not ordered along a multiperipheral chain, possesses these long-range correlations. Therefore the leading J-plane singularity in this model is seen to be a cut. (auth)

25903 LIMITING REGIME OF CROSS SECTIONS IN STRONG INTERACTIONS AT HIGH ENERGY. Logunov, A. A.; Mestvirishvili, M. A.; Khrustalev, O. A. (Inst. of High Energy Physics, Serpukhov, USSR). Teor. Mat. Fiz.; 16: No. 2, 233-234 (Aug 1973). (In Russian).

The consequences are discussed, which can be deduced if one assumes that the cross section increases to the infinity with increasing s. (auth)

25904 MODEL OF MULTIPLE PRODUCTION BASED ON THE INTUITIVE PICTURE OF HADRONS. II. Sasaki, T. (Tokyo Univ.). Progr. Theor. Phys. (Kyoto); 49: No. 4, 1362-1363 (Apr 1973).

An intuitive model of multiple production was previously proposed in which it was assumed that, when two hadrons collide with each other, they overlap and split into a few particles like ζ and ω, and that this splitting continues until they pass through other particles. The results of computer calculations of this model for the mean charged multiplicity and the π distribution function in $p + p \rightarrow \pi^{\pm} + \ldots$ interactions. (LBS)

25905 FRESH LOOK AT THE STATISTICAL BOOTSTRAP MODEL. Gorenstein, M. I.; Miranskii, V. A.; Shelest, V. P.; Zinovyev, G. M. (Inst. for Theoretical Physics, Kiev). Phys. Lett.; 45B: No. 5, 475-477 (20 Aug 1973).

A new interpretation of the statistical bootstrap model is proposed, on the basis of which the statistical bootstrap equation is

modified. A deep relationship between the statistical bootstrap model and the Pomeranchuk model for multiple hadron production is established and as a result the significance of the volume V in the statistical bootstrap model is elucidated. (auth)

25906 ELASTIC SCATTERING FROM THE MULTIPERIPHERAL MODEL. Henyey, F. S. (Univ. of Michigan, Ann Arbor). Phys. Lett.; 45B: No. 5, 469-474(20 Aug 1973).

Elastic scattering in the multiperipheral model (MPM) is examined by use of a new method for simplifying unitary calculations — multiparticle impact parameter. The t dependence of elastic scattering in the MPM is related to the average transverse momentum of produced particles, the average multiplicities (observables), phase variation with transverse momentum, and clustering (not observables, in general). It is shown that MPM's are inconsistent with the combination of elastic and multiparticle data, unless either the cluster size or the phases have rather strong energy dependence. (auth)

25907 RECENT DEVELOPMENTS IN PARTON DYNAMICS. Gunion, J. (Massachusetts Inst. of Tech., Cambridge). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 12, 356-374(1973).

From conference on high energy particle interactions; Nashville, TN (26 Mar 1973).

A summary of a few recent developments in parton dynamics is given. Emphasis is on results for $R = \sigma_L / \sigma_T$, the ratio of longitudinal to transverse total virtual photoabsorption cross sections, and for high transverse momentum processes. (auth)

Strong (Baryon No. = 0)

Refer also to abstracts 25746, 25748, and 26443.

25908 PROTON–ANTIPROTON SCATTERING NEAR THRESHOLD. Lemke, J. L. (Univ. of Chicago). Nuovo Cim.; 16A: No. 3, 473-510(1 Aug 1973).

Recent experiments and theoretical conjectures suggest the presence of unusual features in antiproton-proton scattering near elastic threshold. The content of three classes of simplified phenomenological models of $\bar{p}$-p scattering in the very-low-momentum region ($P_{lab} \lesssim 350$ MeV/c) was analyzed. The models show striking differences in the expected threshold behavior of cross sections and the slope of the forward scattering peak. It is found that the published data strongly favor a class of resonance-dominance models which possess some features of the dual-resonance spectrum. Models with smoothed absorptive amplitudes and those which emphasize structure below threshold would be ruled out. The analysis presented here makes it possible to discriminate between models on the basis of gross features of the data and to interpret systematically the consequences for a choice of model by using new data as they become available. A brief discussion of the apparent non-S-wave behavior near threshold is presented in terms of possible longer-range forces in the $\bar{p}p$ system, and the usefulness of several types of further experiments on $\bar{p}$-p in the low-momentum region is discussed. (auth)

25909 MORRISON RULE IN THE ABFST MULTIPERIPHERAL MODEL. Islam, S. (Imperial Coll. of Science and Tech., London). Nucl. Phys.; B59: No. 2, 600-610(1973).

The validity and consistency of the Morrison rule for the process $\pi\pi \to \pi A_2$ is considered at asymptotic energy in the context of the ABFST multiperipheral model. The Morrison rule turns out to be inconsistent with the model. (auth)

25910 NUCLEON–ANTINUCLEON ANNIHILATION INTO PIONS. Orfanidis, S. J.; Rittenberg, V. (Rockefeller Univ., New York). Nucl. Phys.; B59: No. 2, 570-582(1973).

A statistical model with a new charge weight factor is shown to give a fair description of the nucleon-antinucleon annihilation into pions for the whole available energy range. The model allows one to compare different cross sections observed in $\bar{p}p$ and in $\bar{p}n$ annihilation and to predict various branching ratios in terms of one parameter (whose value is more or less fixed by the model) and the observed average charge multiplicity. (auth)

25911 QUANTUM-NUMBER EXCHANGE IN HADRON COLLISIONS. Albrow, M. G. (CERN, Geneva). Lett. Nuovo Cim.; 7: No. 17, 891-896(25 Aug 1973).

A quantitative definition of quantum-number exchange is proposed which can be applied quite generally to hadronic processes. After some definitions the concept is illustrated by considering examples of two-body, three-body, and four-body processes. The reactions $\pi + \pi$, $\pi + p$, $\bar{p} + p$, and $p + p$ are considered. (JFP)

25912 MULTIPERIPHERAL MODEL OF MESON AND BARYON MULTIPLICITIES. Koplik, J. (Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). Phys. Rev. D 7: No. 11, 3317-3323 (1 June 1973).

We construct a simple coupled-channel multiperipheral model of mesons and baryons in order to calculate their respective multiplicities at high energy. Requiring total cross sections to have their usual Regge behavior constrains the baryon multiplicity to be small, with an upper bound not far from the experimental value. More precise results are difficult to obtain in this context. Arguments are given that this result will be valid in more realistic models. (auth)

25913 ANTIPROTON–NEUTRON BOUND STATE. Ju, I.; Tomozawa, Y. (Randall Laboratory of Physics, The University of Michigan, Ann Arbor, Michigan 48104). Phys. Rev. D 7: No. 11, 3529-3531 (1 June 1973).

We discuss the possibility of an antiproton–neutron bound state for explaining a narrow peak which was found recently in the experiment $\bar{p} + n \to 4\pi$ and 6π. It is pointed out that the state is likely to be a $^1P_1$ state or a higher angular momentum state. (auth)

25914 THEORY OF BOSON RESONANCES. Sugawara, M. (Physics Department, Purdue University, Lafayette, Indiana 47907). Phys. Rev. D 7: No. 11, 3428-3443 (1 June 1973).

We propose a bootstrap theory of boson resonances which consists of new self-consistency conditions for boson resonances. We derive these conditions by saturating in terms of resonances the once-subtracted dispersion relations for their two-body decay amplitudes where subtractions are introduced by choosing appropriately an arbitrary parameter that appears in the usual continuations of these amplitudes. We then study the simplest solution to all these conditions in the sense that the resonances are minimal in their numbers, with the input that pseudoscalar and vector mesons form the observed nonets. The boson spectrum predicted by this solution is not very different from the observed one, some crucial tests of which are also given. (auth)

25915 BOUNDS ON THE MOMENTS OF ABSORPTIVE PARTS OF ELASTIC SCATTERING AMPLITUDES. Balachandran, A. P.; Blackmon, M. L.; Sigaud, C. (Physics Department, Syracuse University, Syracuse, New York 13210). Phys. Rev. D 7: No. 11, 3420-3424 (1 June 1973).

A rigorous set of bounds on the moments of the absorptive part of elastic scattering amplitudes and its derivatives with respect to the cosine of the scattering angle is presented for pion–pion and pion–nucleon scattering. These bounds are similar to unitarity bounds found by Singh and Roy, and involve integrals over absorptive parts and their derivatives in the physical scattering region only. (auth)

25916 KINEMATICS, GAUGE INVARIANCE, HELICITY CONSERVATION FOR $\pi V \to \pi V$ AND RELATED REACTIONS. Hite, G. E.; Müller, H. J. W. (Fachbereich Physik, Universität Trier–Kaiserslautern, Kaiserslautern, Germany). Phys. Rev. D 7: No. 11, 3409-3420 (1 June 1973).

A detailed discussion of the kinematics and Reggeization of pion and vector–meson scattering and crossed reactions is presented in terms of helicity amplitudes and invariant amplitudes. It is shown that the gauge–invariance condition allows a smooth limit to the case of massless vector mesons, i.e., photons, Particular attention is paid to the importance of kinematic constraints. It is shown how they are necessary in obtaining the pion pole in Compton scattering. The total photoabsorption cross section is considered, and it is seen that in order to obtain a finite, nonzero asymptotic value of the cross section, the introduction of a singularity in the appropriate residue is unavoidable, but compatible with kinematic and gauge–invariance constraints. Finally, the conservation of helicity is investigated. It is found that the factorization of the pion residue functions is a necessary condition for conservation of helicity in the $VV \to \pi\pi$ channel. In compton scattering, we find that the kinematic constraints imply the conservation of helicity, provided the total photoabsorption cross section approaches a finite and nonzero limit. (auth)

25917 ODORICO'S BOOTSTRAP OF PSEUDOSCALAR MESONS. Capps, R. H. (Physics Department, Purdue University, West Lafayette, Indiana 47906). Phys. Rev. D 7: No. 11, 3394-3400 (1 June 1973).

Odorico has derived bootstrap conditions for P (pseudoscalar) meson interactions from the hypothesis that the zeros in PP scattering amplitudes are linear in the Mandelstam plane. We explain the relation between this hypothesis and an earlier bootstrap hypothesis based on duality. If the solution proposed by Odorico for the PP scattering bootstrap is correct, other bootstrap conditions involving virtual P mesons suggest that a tenth member should be associated with the P nonet. If the 1422-MeV E meson is pseudoscalar, it is a possible candidate for the tenth member. It is shown that in some, but not all, hadron–hadron scattering amplitudes, a simple condition based on duality and isotopic-spin invariance is almost sufficient to predict linear zeros. (auth)

25918 DUAL $\pi\pi$ PARTIAL-WAVE AMPLITUDES. I. THRESHOLD BEHAVIOR. Chung, B. K.; Feldman, D. (Department of Physics, Brown University, Providence, Rhode Island 02912). Phys. Rev. D 7: No. 12, 3721-3728 (15 June 1973).

A formulation of the integral representations of the dual $\pi\pi$ partial-wave amplitudes is presented. One of the many advantages of these representations is that one can extract the threshold coefficients without difficulty. This is demonstrated in a calculation of the scattering lengths and effective ranges for the s, p, d, and f waves. (auth)

25919 DUAL $\pi\pi$ PARTIAL-WAVE AMPLITUDES. II. ASYMPTOTIC BEHAVIOR. Chung, B. K.; Feldman, D. (Department of Physics, Brown University, Providence, Rhode Island 02912). Phys. Rev. D 7: No. 12, 3728-3737 (15 June 1973).

The integral representations, developed for the partial waves of the dual $\pi\pi$ amplitudes, are used to show that all the partial waves can be expressed as sums involving s waves only, and to prove that the isospin-zero and -two partial waves are bounded by powers in the right half-plane of the energy-squared variable and diverge exponentially along any ray in the left half-plane, thus confirming the behavior conjectured by Tryon. For the isospin-one waves, the derived bounds agree with those of Park and Desai. It also proved that the discontinuities of the isospin-zero and -two partial waves diverge exponentially along the left-hand cuts and those for the isospin-one case are bounded by a power. (auth)

25920 NONLINEAR BOOTSTRAP IN DUAL MODELS. Maharana, J.; Ramachandran, R. (Department of Physics, Indian Institute of Technology, Kanpur, India). Phys. Rev. D 7: No. 12, 3670-3679 (15 June 1973).

We have obtained self-consistency conditions on the coupling constants for meson-meson scattering in a dual resonance model. We have made use of the relations between the total cross section and inclusive cross section for obtaining bootstrap conditions implied by unitarity. The coupling constants $G_{K^*K^*\pi}$ and $G_{A_2\rho\pi}$ are of the right order of magnitude when compared with the experimental results. (auth)

25921 PIONIC TRANSITIONS AS TESTS OF THE CONNECTION BETWEEN CURRENT AND CONSTITUENT QUARKS. Gilman, F. J. (California Inst. of Tech., Pasadena); Kugler, M.; Meshkov, S. Phys. Lett.; 45B: No. 5, 481-486(20 Aug 1973).

A proposed connection between current and constituent quarks is discussed and tested through comparison with the magnitudes and signs of amplitudes for pionic transitions between hadrons. (auth)

25922 LOW ENERGY THEOREMS WITH APPLICATION TO $\bar{p}p$ ANNIHILATIONS. Nuthakki, P. Chestnut Hill, MA; Boston Coll. (1973). 194p. University Microfilms Order No. 73-21,724.

Thesis (Ph. D.).

Current algebra and PCAC are used to arrive at the low energy theorem for a two pion emission process. It is shown that the same theorem can be derived from a chirally symmetric effective Lagrangian. Two separate soft pion emission processes are considered: $\bar{p}p \to K^+K^-\pi^0\pi^0$ and $\bar{p}p \to K^+K^-K^+K^-\pi^0\pi^0$. For each case the differential rate normalized to the total rate for the reaction where the pions are absent is calculated. In the four kaon emission process the threshold kaon production is considered to evaluate the spin average of the square of the matrix element, that is, $\Sigma_i\Sigma_f|M_{fi}|^2$. The expressions for differential rates were numerically integrated to arrive at the ratios of total cross sections both processes at various energies, i.e., $(\bar{p}p \to K^+K^-\pi^0\pi^0/\bar{p}p \to K^+K^-)$ and $(\bar{p}p \to K^+K^-K^+K^-\pi^0\pi^0/\bar{p}p \to K^+K^-K^+K^-)$. For comparison of the results with experiment data is in many cases lacking and is most copious for $\bar{p}p \to K^+K^-\pi^0\pi^0$ at rest. The general agreement with experiment is reasonable. (auth)

25923 NEW $K\pi$ PARTIAL WAVE ANALYSIS BELOW 1 GeV $K\pi$ MASS. Barbaro-Galtieri, A.; Matison, M. J.; Alston-Garnjost, M.; Flatte, S. M.; Friedman, J. H.; Lynch, G. R.; Rabin, M. S.; Solmitz, F. T. (Univ. of California, Berkeley). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 13, 1-25(1973).

From international conference on $\pi-\pi$ scattering and associated topics; Tallahassee, Florida (28 Mar 1973).

The $K\pi$ scattering for $M(K\pi) < 1$ GeV was studied in the reaction $K^+p \to \Delta^{++}K^+\pi^-$ at 12 GeV/c incident K^+ momentum. Both the moments of the $K\pi$ angular distribution and the $K\pi$ cross section are extrapolated to the pion pole, and the results are used in a partial wave analysis. For the s wave both an energy-independent and an energy-dependent partial wave analysis were done. It is found that only the so-called "down" solution is compatible with the data; that is, a phase shift δ_0^1 slowly increasing from 20° at 800 MeV to 60° at 1000 MeV. No evidence for an s-wave resonance near the K*(890) mass is found, although a resonance with $\Gamma < 7$ MeV cannot be excluded by the data. The "down" solution is well represented by an effective range formula with $a_0^1 = -0.33 \pm 0.05$, in good agreement with a current algebra calculation. (auth)

25924 $K_{\ell 4}$ DECAYS AND LOW ENERGY $\pi-\pi$ PHASE SHIFTS. Beier, E. W. (Univ. of Pennsylvania, Philadelphia). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 13, 26-36(1973).

From international conference on $\pi-\pi$ scattering and associated topics; Tallahassee, Florida (28 Mar 1973).

The determination of the low energy $\pi-\pi$ phase shifts from the decays $K^\pm \to \pi^+\pi^-e^\pm\nu$ is discussed. Results of the University of Pennsylvania K_{e4} experiment are presented. These results are compared with higher energy data on the $\pi-\pi$ phase shifts and with the results of another K_{e4} experiment. (auth)

25925 $\pi\pi$ PHASE SHIFT ANALYSIS. Estabrooks, P. (CERN, Geneva); Martin, A. D.; Grayer, G.; Hyams, B.; Jones, C.; Weilhammer, P.; Blum, W.; Dietl, H.; Koch, W.; Lorenz, E.; Luetjens, G. AIP (Amer. Inst. Phys.) Conf. Proc.; No. 13, 37-79(1973).

From international conference on $\pi-\pi$ scattering and associated topics; Tallahassee, Florida (28 Mar 1973).

An energy independent $\pi\pi$ phase shift analysis in the energy range $440 < M_{\pi\pi} < 1400$ MeV was performed using high statistics $\pi^-p \to \pi^-\pi^+n$ data at 17.2 GeV/c. The method is based on an amplitude analysis of the production process and the extrapolation of the dominant π exchange amplitudes to the π exchange pole. The phase shift ambiguities are considered and ways of selecting the physical solution are studied. The parameters of the ρ and f resonances are determined. An $I = 0$ S wave resonance is found under the f, and comments are made on the properties of the S* resonance near the $K\bar{K}$ threshold. (auth)

25926 HIGH ENERGY $\pi-\pi$ SCATTERING. Walker, W. D. (Duke Univ., Durham, NC). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 13, 80-88(1973).

From international conference on $\pi-\pi$ scattering and associated topics; Tallahassee, Florida (28 Mar 1973).

A study has been done of $\pi^- - \pi^+$ and $\pi^- - \pi^-$ scattering using the reactions $\pi^- + p \to \pi^- + \pi^+ + n$ and $\pi^- + p \to \pi^- + \pi^- + \Delta^{++}$. The elastic scattering cross section shows a steady decrease from 120 mb (for $\pi^- - \pi^+$) in the region of the ρ^0 to 1-2 mb in the 2-4 GeV/c^2 mass range. Estimates of the total cross section are also made using the optical theorem. Both the $\pi^- - \pi^+$ and $\pi^- - \pi^+$ cross sections seem to be about 15 mb in the high mass region. (auth)

25927 ZEROS IN $\pi\pi$ SCATTERING. Pennington, M. R. (Univ. of California, Berkeley). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 13, 89-116(1973).

From international conference on $\pi-\pi$ scattering and associated topics; Tallahassee, Florida (28 Mar 1973).

It is discussed how zeros in $\pi\pi$ scattering relate various dynamical aspects of the scattering amplitude. In particular, the way in which many differing roles, such as the Legendre zeros of resonances, double-pole-killing zeros, the high energy crossover zero and the Adler zero, can be played by the same zero contour is considered. It is emphasized that the study of the scattering amplitude is essentially one of looking at zeros travelling across the Mandelstam plane. (auth)

25928 $\pi-\pi$ COUPLED CHANNELS. Williams, P. K. (Florida State Univ., Tallahassee). AIP (Amer Inst. Phys.) Conf. Proc.; No. 13, 135-143(1973).

From international conference on $\pi-\pi$ scattering and associated topics; Tallahassee, Florida (28 Mar 1973).

A few observations are made relating to: various inelastic channels which couple to the $\pi-\pi$ system; coupled channel analysis especially near the $K\bar{K}$ threshold; the π-exchange production mechanism and absorption. Finally, a method for measuring the $\pi-\pi$ total cross section from the inclusive reaction $\pi^+p \to \Delta^{++}$ + anything is discussed. (auth)

25929 PARTIAL WAVE ANALYSIS IN 2 → 3 BODY REACTIONS AND COMMENTS ON INELASTIC FINAL STATES IN $\pi\pi$ AND $K\pi$ SCATTERING. Cashmore, R. J. (Stanford Univ., CA). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 13, 144-152(1973).

From international conference on $\pi-\pi$ scattering and associated topics; Tallahassee, Florida (28 Mar 1973).

Multiparticle states derived from $\pi\pi$ and $K\pi$ scattering are discussed and the techniques for analysis of 3 body final states are described. The role that inelastic reactions play in determination of resonance parameters is investigated and the conclusion reached that they only provide information on the specific inelastic channel couplings. Thus the identification of resonances coupling to $\pi\pi$ or $K\pi$ systems is most easily made by observation of the elastic and charge exchange reactions. (auth)

25930 AMPLITUDE ANALYSES OF HYPERCHARGE EXCHANGE REACTIONS. Field, R. D. (Brookhaven National Lab., Upton, NY). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 13, 153-187(1973).

From international conference on $\pi-\pi$ scattering and associated topics; Tallahassee, Florida (28 Mar 1973).

The determination of the two-body production amplitudes for $Y = 1$ exchange reactions is discussed. The pseudoscalar production line reversed reactions $K^-n \to \pi^-\Lambda$ and $\pi^-p \to K^0\Lambda$; the

vector-meson production reactions $K^-p \to (\omega,\varphi)\Lambda$ and $\pi^-p \to K^{*0}\Lambda$; the reaction $K^-p \to \pi^-Y^{*+}(1385)$; and the photoproduction reaction $\gamma p \to K^+\Lambda$ are examined. Quark model, SU(3), and VDM comparisons are made and the EXD nature of the K** and K* Regge exchanges explored. In addition the behavior of the unnatural parity Y = 1 exchanges (K, K_B, K_A) are investigated. (auth)

25931 $\pi\pi$ PHASE-SHIFT ANALYSIS FROM 600 TO 1900 MeV. Hyams, B. (CERN, Geneva); Jones, C.; Weilhammer, P.; Blum, W.; Dietl, H.; Grayer, G.; Koch, W.; Lorenz, E.; Luetjens, G.; Maenner, W.; Meissburger, J.; Ochs, W.; Stierlin, U.; Wagner, F. AIP (Amer. Inst. Phys.) Conf. Proc.; No. 13, 206-246(1973).

From international conference on $\pi-\pi$ scattering and associated topics; Tallahassee, Florida (28 Mar 1973).

An energy-dependent and an energy independent-analysis of elastic $\pi\pi$ scattering was performed using data for the reaction $\pi^-p \to \pi^-\pi^+n$ at 17.2 GeV/c. The $\pi\pi$ energy covers the range from 600 MeV to 1900 MeV. Apart from the well-known resonances ρ, f and g, a strong S-wave is found in the ρ and also in the f-meson region. A P-wave resonance occurs in both analyses at ~1600 MeV with a total width of 180 MeV and an elasticity of 0.25, which can be identified with the ρ' meson in its $\pi\pi$ decay mode. The zeros in the complex $\cos\theta$ plane of the scattering amplitude are studied as a function of the energy. The position of the real parts of the zeros are in qualitative agreement with the prediction of the Veneziano model. Furthermore, it is shown that an analogous relation holds also for the imaginary parts of the zero trajectories. (auth)

25932 LEARNING ABOUT MESON STATES FROM THEIR PRODUCTION PROPERTIES. Kane, G. L. (Univ. of Michigan, Ann Arbor). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 13, 247-254(1973).

From international conference on $\pi-\pi$ scattering and associated topics; Tallahassee, Florida (28 Mar 1973).

An attempt is made to increase the awareness of the value of including information on production mechanisms in the study of hadron resonances and meson–meson scattering. (auth)

25933 EXTRAPOLATION TECHNIQUE USED BY THE SLAC GROUP IN THEIR MEASUREMENT OF THE $\pi^+\pi^-$ CROSS SECTION. Baillon, P. (CERN, Geneva). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 13, 260-269(1973).

From international conference on $\pi-\pi$ scattering and associated topics; Tallahassee, Florida (28 Mar 1973).

The extrapolation technique used by the S.L.A.C. Boson spectrometer group to measure the $\pi^+\pi^-$ cross section and phase shift is described. The errors introduced by a limited polynomial expansion of the extrapolated curve are discussed. (auth)

25934 EXTRAPOLATION WITH COMPLEX TRANSFORMATION. Laurens, G. (CEN de Saclay, Gif-sur-Yvette, France). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 13, 270-273(1973).

From international conference on $\pi-\pi$ scattering and associated topics; Tallahassee, Florida (28 Mar 1973).

Some complex transformations used to obtain the $\pi\pi$ cross section by Chew and Low extrapolation are succinctly described. (auth)

25935 A_2-EXCHANGE AND POLARIZATION EFFECTS IN THE ANALYSIS OF $\pi\pi$ SCATTERING. Kimel, J. D.; Reya, E. (Florida State Univ., Tallahassee). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 13, 274-283(1973).

From international conference on $\pi-\pi$ scattering and associated topics; Tallahassee, Florida (28 Mar 1973).

It is shown from a $\pi + A_2$ model analysis of the high-statistics CERN-Munich data on $\pi^-p \to \pi^-\pi^+n$ at 17.2 GeV/c that A_2 exchange contributions are significant even in the near forward direction. A unique amplitude analysis, utilizing nucleon polarization information and taking into account this more complex production mechanism, is developed which will yield uniquely the phase of the $\pi\pi$ s-wave amplitude. (auth)

25936 THEORETICAL CALCULATION OF LOW ENERGY $\pi\pi$ SCATTERING. Jhung, K. S.; Willey, R. S. (Univ. of Pittsburgh). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 13, 327-331(1973).

From international conference on $\pi-\pi$ scattering and associated topics; Tallahassee, Florida (28 Mar 1973).

A theoretical calculation of the $\pi\pi$ s- and p-wave phase shifts below one GeV/c is presented. The calculation is based on the Padé approximant technique applied to the one loop approximation computed from the nonlinear σ-model lagrangian. (auth)

25937 PION FORM FACTOR AND INELASTIC $\pi-\pi$ SCATTERING. Goble, R. L. (Univ. of Utah, Salt Lake City). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 13, 342-345(1973).

From international conference on $\pi-\pi$ scattering and associated topics; Tallahassee, Florida (28 Mar 1973).

A lightning review is first given of the principal features of $\pi-\pi$ scattering and of the generally accepted theoretical picture (using current algebra and smoothness) which accounts for most of these features. This is followed by a brief look into the future, in which it is argued that P-wave $\pi-\pi$ scattering will continue to play a prominent role in experiment and theory at energies above 1 GeV, just as it does at lower energies. Finally, calculations are presented which indicate that the theoretical picture of low energy $\pi-\pi$ P-wave scattering and the pion form factor is not noticeably modified by the inelastic states which will be prominent at higher energies. This result depends on the use of current algebra constraints for inelastic scattering and is not necessarily true of I = 0, S-wave scattering, since the current algebra provides less stringent constraints for I = 0 inelastic scattering. (auth)

25938 PHENOMENOLOGY OF $\pi\pi$ SCATTERING. Basdevant, J. L. (Faculte des Sciences, Paris); Froggatt, C. D.; Petersen, J. L. AIP (Amer. Inst. Phys.) Conf. Proc.; No. 13, 346-350(1973).

From international conference on $\pi-\pi$ scattering and associated topics; Tallahassee, Florida (28 Mar 1973).

The set of $\pi\pi$ amplitudes below 1100 MeV consistent with all present experimental information and the requirements of crossing, unitarity and analyticity is presented. The corresponding $\pi\pi$ scattering lengths lie on a universal curve and it is discussed how further experiments can resolve these final ambiguities in their values. It is illustrated in what sense the Roy equations cannot resolve the "up-down" ambiguity. (auth)

25939 COMMENTS ON PHENOMENOLOGY OF $\pi\pi$ SCATTERING. Pennington, M. R. (Univ. of California, Berkeley); Protopopescu, S. D. AIP (Amer. Inst. Phys.) Conf. Proc.; No. 13, 351-353(1973).

From international conference on $\pi-\pi$ scattering and associated topics; Tallahassee, Florida (28 Mar 1973).

It is discussed how our aims and methods of applying Roy's equations to a particular set of data differ from those of Basdevant, Froggatt and Petersen and it is emphasized that there is no disagreement between us concerning s-wave scattering lengths. (auth)

Strong (Baryon No. = 1)

Refer also to abstracts 25776, 26002, and 26003.

25940 (EFI-TF-8(71)) ESTIMATION OF THE CONTRIBUTION OF AN INTERMEDIATE ENERGY REGION INTO THE DISPERSION SUM RULES AND THE ROTATION OF POLARIZATION IN PION-NUCLEON SCATTERING AT HIGH ENERGIES. Aznauryan, I. G.; Soloviev, L. D. (Akademiya nauk Armyanskoi SSR, Erevan. Institut Fiziki). 1971. 16p. INIS.

A method is developed to account the intermediate energy region in the dispersion sum rules. The method makes it possible to find the parameters for the high energy processes with use of the low-energy phase-shift analysis. The method is applied to obtain the spin-rotation parameters in pion-nucleon scattering at energies above 4 GeV. (auth)

25941 QUANTUM NUMBER TRANSFER IN K^-p INTERACTIONS. Aachen–Berlin–CERN–London–Vienna Collaboration, Aachen. Nucl. Phys.; B59: No. 2, 333-347(1973).

Five-body final states from K^-p interactions at 6, 10 and 16 GeV/c are separated into sub-reactions depending upon which particles go forward in the cm system. The relative population and energy dependence of the various sub-reactions are shown to be closely related to the quantum numbers exchanged between the forward and backward going particles. In particular the energy dependence is the same as that found for the production of two-body final states involving exchange of the same quantum numbers. Single diffraction dissociation of the incident kaon and proton are shown to be important processes in these five-body states. This technique of separating events is referred to as binary LPS. (auth)

25942 SIMPLE RELATIVISTIC PARAMETRIZATION OF THE $\Delta(1236)$. Tschang, Y.; Parkinson, M. (Univ. of Florida, Gainesville). Nucl. Phys.; B59: No. 2, 445-459(1973).

A relativistic generalization of the Breit–Wigner formula is extended to higher spin resonances and applied to the P_{33}^i resonance. A good fit is obtained. Several coupling constants involving the $\Delta(1236)$ are determined. (auth)

25943 VECTOR-MESON DOMINANCE AND THE MASS DEPENDENCE OF BALL'S INVARIANT AMPLITUDES. Svec, M. (McGill Univ., Montreal). Lett. Nuovo Cim.; 7: No. 17, 871-875 (25 Aug 1973).

The dependence of amplitudes on one or more external masses in processes involving virtual photons are treated. The processes $\rho^0 + N \to \pi + N$, $\omega + N \to \pi + N$, and $\gamma + N \to \pi + N$ are considered. (JFP)

25944 RESCATTERING MODEL OF $K^{\pm}p$ ELASTIC LARGE-ANGLE COLLISIONS AT HIGH ENERGIES. Masuda, N. (Louisiana State Univ., Baton Rouge); Mikamo, S. Lett. Nuovo Cim.; 7: No. 17, 879-884(25 Aug 1973).

An attempt is made to fit the data on $K^+ + p$ and $K^- + p$ elastic differential cross sections in the scattering angle region from 40 to 100° with the result of the rescattering model, and it is studied whether the rescattering model is acceptable or not as a collision mechanism at large angles. (JFP)

25945 DESCRIPTION OF $\pi^- p \to c$ + ANYTHING AT 16 GeV/c LABORATORY MOMENTUM IN THE TRIPLE-REGGE LIMIT. Nowak, H.; Schreiber, H. J. (Institut fuer Hochenergiephysik, Berlin). Lett. Nuovo Cim.; 8: No. 1, 21-26(1 Sep 1973).

The triple-Regge limit for inclusive spectra is studied for the reactions $\pi^- + p \to \pi^-(\pi)^+ +$ anything and $\pi^- + p \to p +$ anything. The differential cross sections and the effective trajectory are found. It is concluded that a simple Regge model applied to inclusive particle spectra yields values of the effective exchange trajectory as expected from two-body reactions. (JFP)

25946 REGGE-POLE MODEL OF CHARGE EXCHANGE AND HYPERCHARGE EXCHANGE REACTIONS. Kenmoku, M.; Kuroda, T. (Tokyo Univ. of Education). Lett. Nuovo Cim.; 8: No. 1, 43-52(1 Sep 1973).

The forward $\pi + p$, $K + p$, and $K + n$ charge and hypercharge exchange processes are studied by using πN isospin-one exchange amplitudes and assuming a Regge-pole model with daughter trajectories. The differential cross sections and polarization parameters are found. (JFP)

25947 MARKOV–YUKAWA CONDITIONS AND NUCLEON FORM FACTORS IN THE RELATIVISTIC QUARK MODEL. Dushenko, V. F.; Kobushkin, A. P.; Sinyukov, Yu. M. (Inst. for Theoretical Physics, Kiev). Lett. Nuovo Cim.; 8: No. 1, 11-15(1 Sep 1973).

The Markov–Yukawa conditions are used to normalize the Bethe–Salpeter wave functions in the relativistically invariant quark model with oscillator interaction. With this model, without using any free parameters, one gets good agreement of the nucleon form factor behavior with experiment in a wide range of k^2. (JFP)

25948 MULTIPLICITY OF NEUTRAL PIONS IN HIGH ENERGY COLLISIONS. Bardadin-Otwinowska, M.; Bialkowska, H.; Gajewski, J.; Gokieli, R.; Otwinowski, S.; Wojcik, W. (Univ., Warsaw). Acta Phys. Pol.; B4: No. 4, 561-571(1973).

The experimental characteristics of the π^0 production is studied in high energy $\pi^- p$ and pp collisions. The observed features of charged multiplicity distribution and neutral pion production are described by a phenomenological model which assumes a Czyzewski-Rybicki formula for the total multiplicity distribution and the hypothesis of isospin independence. (auth)

25949 TEST OF THE T-CHANNEL PARITY EXCHANGE FOR THE REACTION $K^+ + p \to K^{*0}(1420) + \Delta^{++}$ IN THE QUARK MODEL. Muryn, B. (Academy of Mining and Metallurgy, Krakow). Acta Phys. Pol.; B4: No. 4, 461-466(1973).

Linear relations between the double statistical tensors describing the decay angular distributions of resonances produced in the reactions $0^- + \frac{1}{2}^+ \to J^P + \frac{3}{2}^+$ are derived using the additive quark model. Some of these relations enable one to test spin-parity assignment of the produced meson resonance J^P. Others may be used to study the contributions of natural and unnatural exchange in the t-channel. The reaction $K^+ + p \to K^{*0}(1420) + \Delta^{++}$ at 5 GeV/c is studied, and it is found that unnatural parity exchange dominates in this case. (auth)

25950 IMPACT PARAMETER EXPANSION OF πN SCATTERING AMPLITUDES AT INTERMEDIATE ENERGIES. Hoehler, G.; Jakob, H. P. (Univ., Karlsruhe, Ger.). Z. Phys.; 261: No. 5, 371-400(1973).

Impact parameter transforms of isospin even no-flip πN-amplitudes and of the overlap function are calculated from the new CERN phase shifts. The results are compared with different models. The approximate equality of the partial wave and the impact transform for $bq = (l + \frac{1}{2})$ is valid for small l and not for large l as frequently assumed. The "optical potential" has a repulsive core in the real part and rather flat tails beyond 0.5 fermi in the real and imaginary parts. (GE)

25951 BACKWARD $K^{\pm}p$ ELASTIC SCATTERING AND THE EXISTENCE OF Z_1. Karasuno, T. (Osaka City Univ.). Progr. Theor. Phys. (Kyoto); 49: No. 3, 885-895(Mar 1973).

Taking into account the effects of the exotic resonances Z*, the backward $K^{\pm}p$ elastic scattering from 1.5 to 7.0 GeV/c is described. It is shown that the present experimental results are successfully reproduced by our model. The quantitative success of this model gives a support to the existence of Z*. (auth)

25952 πN CHARGE-EXCHANGE FORWARD SCATTERING AT HIGH ENERGIES. Hoehler, G.; Jakob, H. P.; Kroll, P. (Univ., Karlsruhe, Ger.). Z. Phys.; 261: No. 5, 401-412(1973).

The unsubtracted dispersion relation is not compatible with the charge-exchange data, if a power law is assumed for the total cross section difference at high energies and the exponent is taken from the fit to the Serpuchov data. However, there is no difficulty for the subtracted dispersion relation. Recent estimates of a finite high energy limit of the total cross section difference and a possible substantial curvature of the ρ-trajectory near $t = 0$ are discussed. (GE)

25953 BARYON SPECTRUM AND REFLECTION PARTNERS. Ida, M. (Kyoto Univ.). Progr. Theor. Phys. (Kyoto); 49: No. 4, 1259-1370(Apr 1973).

An SU(3) Regge scheme proposed previously, which classifies baryon trajectories into four Regge families, is reexamined. A switch phenomenon is considered for two mutually crossing octet trajectories with the same quantum numbers. The nucleon trajectory can now pass through a wrong-signature nonsense point at u around -0.15 $(GeV/c)^2$. As a consequence of the switching there emerge two kinds of reflection partners, local and global. The baryon spectrum is discussed again in the new scheme, by taking account of this peculiarity of octet trajectories. (auth)

25954 PHASES OF RESONANT AMPLITUDES: $\pi N \to \pi\Delta$. Faiman, D.; Rosner, J. (CERN, Geneva). Phys. Lett.; 45B: No. 4, 357-360(6 Aug 1973).

The phases of resonant amplitudes in $\pi N \to \pi\Delta$ are studied in a modified version of $SU(6)_W$ in which amplitudes involving different relative orbital angular momenta l are uncoupled from one another. This form of $SU(6)_W$ is equivalent to one studied recently by Melosh, in which the set of selection rules for decays is extended to allow for more types of transition than in the original version of this symmetry. The predictions are compared with a recent preliminary analysis by Herndon et al. Even the extended ("l-broken") version of $SU(6)_W$ is found to disagree with the present experimental solution. If this solution persists, it constitutes the strongest present evidence against such a symmetry. (auth)

25955 TENSOR–MESON EXCHANGE AMPLITUDES. Martin, A.; Stevens, P. R. (Michigan State Univ., East Lansing). Lett. Nuovo Cim.; 7: No. 16, 821-829(18 Aug 1973).

It is suggested that the imaginary part of the s-channel helicity-flip zero amplitude is not peripheral for the leading tensor exchanges. The general systematics expected for tensor-exchange amplitudes in an absorption model with effective rescattering are presented. Some detailed fits to the differential cross section and polarization in $\pi^- p \to \eta n$ are then discussed for illustration. The results are compared to other analyses which have attempted to determine the structure of tensor-exchange amplitudes. Finally, the results for tensor exchange are combined with previously obtained results for vector exchange, and the implications of this type of model for reactions related by line reversal are discussed. (LBS)

25956 REGGE ANALYSIS OF ELASTIC K–NUCLEON DATA. Baccari, B. (College de France, Paris); Derem, A. Nuovo Cim.; 17A: No. 1, 125-161(1 Sep 1973).

The available data on elastic K-nucleon reactions are analyzed at high energy in terms of P, P', ω, ρ and A_2 Regge poles, together with associated cuts. The data include the recent measurements of the total cross section at Serpukhov, new experiments on the polarization parameter P in $K^{\pm}p$ scattering and some very precise differential cross sections. The phenomenological analysis extends from 4 GeV/c upwards, for $|t| < 1.5$ $(GeV)^2$, and is extrapolated down to 2 GeV/c. Particular attention was paid to the part of the amplitude which has the quantum numbers of the ω. The constraint $A' = \nu B$ was imposed on the P and P' terms, as found from the continuous-moment sum rules. A reasonable fit is obtained for all the data, though the solutions possibly do not account for some very fine structures in the differential cross sections. (auth)

25957 IMPULSE APPROXIMATION AND MULTIPLE-SCATTERING SERIES FOR $\pi^+ d \longrightarrow pp$ AT HIGH ENERGY. Dean, N. W. (Ames Laboratory–USAEC and Department of Physics, Iowa State University, Ames, Iowa 50010). Phys. Rev. D 7: No. 11, 3349-3355 (1 June 1973).

A new model for $\pi^+ d \longrightarrow pp$ at high energy, based on the impulse approximation, is formulated. It is observed that the shape of the differential cross section for this process is qualitatively consistent with the deuteron momentum-space density, implying that nuclear structure plays a dominant role in determining the momentum-transfer distribution. Despite the drastically nondiffractive nature of the reaction, a multiple-scattering-like series can be formulated from the Lippmann-Schwinger equation and evaluated by the linearized-propagator method. The resulting amplitude yields a good

four-parameter fit to pp → π^+d data at 3.74, 10.0, 14.2, 21.1, and 24.0 GeV/c. Arguments against some aspects of the Reggeistic interpretation of this process are also presented. (auth)

25958 CHIRAL SYMMETRY BREAKING, PARTIAL CONSERVATION OF AXIAL-VECTOR CURRENTS, AND THE σ COMMUTATOR IN THE KAON-NUCLEON SYSTEM. Reya, E. (Department of Physics, Florida State University, Tallahassee, Florida 32306, USA). Phys. Rev. D 7: No. 11, 3472-3485 (1 June 1973).

Chiral-symmetry-breaking effects are studied in the kaon-nucleon system, and discussed and compared with various symmetry-breaking schemes. We first derive a relation between low-energy parameters of the kaon-nucleon scattering amplitude and s- and p-wave scattering lengths, where contributions from $\bar{K}N$ unphysical regions and nearby singularities are calculated from field theory. This sum rule is nearly saturated. Together with consistency conditions of the isospin-even amplitude, the nucleon expectation value of the σ commutator is expressed in terms of s- and p-wave scattering lengths and a rather well-known integral over $K^{\pm}N$ cross sections. Although definitely not compatible with the recent estimate of Cheng and Dashen, our result for the magnitude of the σ term is in agreement with most of the calculations for the πN system and favors the (conventional) $(3,\bar{3}) + (\bar{3},3)$ breaking scheme of SU(3) × SU(3) of Gell-Mann, Oakes, and Renner. The same conclusion has been reached by using a dispersive approach. Since these σ terms turn out to be slightly larger (by about a factor of 2) than conventional $(3,\bar{3})$ estimates, mechanisms and models are discussed in order to explain this (possible) enhancement. Nonsmooth higher-order effects due to the A' (1520) are found to be small, suggesting that even in the kaon-nucleon system second-order effects in chiral symmetry breaking, i.e., $O(m_K{}^4)$, can be neglected. Finally, PCAC (partial conservation of axial-vector current) for kaons has been directly compared with experiment using most recent phase-shift analyses, and its compatibility with the data has been confirmed, as suggested by generalized Goldberger-Treiman relations, contrary to previous calculations. (auth)

25959 IMPLICATIONS FOR THE $\Delta N\pi$ INTERACTION AND σ TERM FROM LOW-ENERGY πN SCATTERING. Olsson, M. G.; Turner, L. (Department of Physics, University of Wisconsin, Madison, Wisconsin 53706); Osypowski, E. T. Phys. Rev. D 7: No. 11, 3444-3455 (1 June 1973).

A model for low-energy πN scattering consisting of N, ρ, Δ, and σ exchanges together with current-algebra constraints is presented. We derive the Δ contributions to the scattering amplitude using a general Δ propagator and $\pi N\Delta$ interaction. We show that the data are consistent with the simplest structure for both the Δ propagator and the interaction. A σ term of 42 ± 10 MeV at the Cheng-Dashen point is found, and predictions of the σ term at t = 0, the πNN coupling constant, and the isospin-even s-wave scattering length are made. (auth)

25960 UNITARITY AND ANALYTICITY BOUNDS ON PION-NUCLEON HELICITY AMPLITUDES. Hahn, B. D.; Hodgkinson, D. P. (Cavendish Laboratory, Cambridge, England). Phys. Rev. D 7: No. 11, 3380-3385 (1 June 1973).

Unitarity and analyticity bounds on the absorptive parts of $\pi^{\pm}$p s-channel helicity amplitudes are compared with the results of a recent amplitude analysis. It is found that in particular the helicity-flip amplitude is severely restricted in the forward region. (auth)

25961 REGGE POLE AND CUT MODEL OF PION-NUCLEON CHARGE EXCHANGE. Coleman, J. W.; Johnson, R. C. (Mathematics Department, Durham University, United Kingdom). Phys. Rev. D 7: No. 11, 3386-3394 (1 June 1973).

The reaction π^-p→π^0n is described quantitatively in a model involving a nonsense-choosing ρ Regge pole modified by a mainly imaginary and spin-nonflip $\rho_{\mathbb{P}}$P-type Regge cut. The details are determined with the aid of continuous-moment finite-energy sum rules, as well as scattering data. The Regge cut is found to have peaked t dependence and approximately evasive behavior at t=0. This feature (in addition to its phase and spin coupling) disagrees strongly with predictions of conventional Regge-cut models. Some implications are mentioned. (auth)

25962 LIMITS ON PION-NUCLEON CHARGE-EXCHANGE POLARIZATION. Dean, N. W.; Long, W. F. (Ames Laboratory-USAEC and Department of Physics, Iowa State University, Ames, Iowa 50010). Phys. Rev. D 7: No. 11, 3356-3358 (1 June 1973).

Triangle inequalities implied by isosymmetry yield upper and lower bounds for the pion-nucleon charge-exchange polarization in terms of the elastic $\pi^{\pm}$p differential cross sections and polarizations and the π^-p → π^0n differential cross section. We have evaluated these bounds at a number of energies and observe an intriguing regularity: The upper and lower bounds approach each other closely, "pinching" the polarization value, at certain values of the center-of-mass scattering angle which are essentially independent of the energy. (auth)

25963 EXTRACTION OF HIGH-ENERGY PARTICLE INFORMATION FROM COSMIC-RAY EMULSION DATA. Fishbane, P. M.; Trefil, J. S. (University of Virginia, Charlottesville, Virginia 22901); Newmeyer, J. L. Phys. Rev. D 7: No. 11, 3324-3331 (1 June 1973).

The use of data from cosmic-ray interactions with dense targets is discussed from the point of view of extracting information on p-p interactions at high (cosmic ray) energies. We present a result which relates single-particle inclusive distributions on nuclear targets to single-particle inclusive distributions on nucleons. We show that there exists no serious conflict between present nuclear data and a flat pionization region. (auth)

25964 NEW RIGOROUS UPPER BOUND FOR THE RENORMALIZATION CONSTANT OF THE NUCLEON. Baluni, V.; Broadhurst, D. J. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). Phys. Rev. D 7: No. 12, 3738-3749 (15 June 1973).

From the analyticity properties of the nucleon propagator and the improper πNN vertex function a new upper bound is established for Z_2, the wave-function renormalization constant of the nucleon, in terms of the pion-nucleon coupling constant g and the P_{11} and S_{11} elastic πN phase shifts. The result is $Z_2^{-1} - 1 \geq 0.096(g^2/4\pi)$, $Z_2 \leq 0.42$, representing improvements by factors of 8 and 2, respectively, over a previous bound obtained by Drell, Finn, and Hearn. In addition the phase of the one-nucleon-irreducible P_{11} πN partial-wave amplitude, in the elastic region, is calculated in an N/D approximation. The results of this calculation strongly suggests the existence of a zero of the nucleon propagator function, the possibility of which has been widely discussed in connection with the validity of an upper bound on $g^2/4\pi$. (auth)

25965 ANALYTIC PHASE-SHIFT ANALYSIS. Atkinson, D. (Univ., Groningen, Netherlands); Mahoux, G.; Yndurian, F. J.; Yndurain, F. J. J. Phys. (Paris); 34: No. 7, 495-497(Jul 1973).

From the knowledge of the π^+p and π^-p elastic differential cross sections and polarizations below the inelastic threshold, the charge-exchange cross section and polarization, and all the A and R parameters can be predicted. However, in the inelastic region, a measurement of all observables is not sufficient to remove a continuum ambiguity in the determination of the phase-shifts. (FR)

25966 CHARGED MULTIPLICITY DISTRIBUTIONS IN HIGH ENERGY PARTICLE COLLISIONS. Dao, F. T.; Lach, J.; Whitmore, J. (National Accelerator Lab., Batavia, IL). Phys. Lett.; 45B: No. 5, 513-516(20 Aug 1973).

Data on hadron-proton collisions ranging from 1 to 300 GeV/c in incident momentum show evidence for an energy-dependent approach to a single semi-inclusive scaling curve for the charged multiplicity cross sections as predicted by Koba, Nielsen and Olesen. The onset of this scaling behavior is shown to depend on the initial state hadrons. The relation between the onset of this apparent scaling and the approach to a constant value of $\langle n \rangle / D$ is suggestive of a two-component process. (auth)

25967 SYSTEMATICS OF VECTOR AND TENSOR EXCHANGE AMPLITUDES: THE COMPLEX POLE MODEL. Desai, B. R. (CEN de Saclay, Gif-sur-Yvette, France); Stevens, P. R. Phys. Lett.; 45B: No. 5, 497-502(20 Aug 1973).

Based on the theory of complex Regge poles, a simple systematics is suggested for vector and tensor-meson exchange amplitudes. The amplitudes give a detailed, quantitative description of high energy cross-section and polarization data for charge and hypercharge exchange reactions. The presence of ghost-eliminating zeroes distinguishes the tensor from the vector exchange. SU_3 constraints are applied and the amplitudes found are approximately exchange degenerate at t = 0. (auth)

25968 COUPLED CHANNEL ANALYSIS IN THE $K\bar{K}$ THRESHOLD REGION. Grayer, G. (CERN, Geneva); Hyams, B.; Jones, C.; Schlein, P.; Weilhammer, P.; Blum, W.; Dietl, H.; Koch, W.; Lorenz, E.; Luetjens, G.; Maenner, W.; Meissburger, J.; Ochs, W.; Stierlin, U. AIP (Amer. Inst. Phys.) Conf. Proc.; No. 13, 117-134(1973).

From international conference on $\pi-\pi$ scattering and associated topics; Tallahassee, Florida (28 Mar 1973).

Results of an energy-dependent phase-shift analysis for $\pi\pi$ scattering between 900 and 1120 MeV mass are presented using data of the reactions $\pi^{\pm}$p → $\pi^{\pm}\pi^+$n and π^-p → K^+K^-n. The I = 0 S-wave becomes highly inelastic at $K\bar{K}$ threshold and accounts for the structure in the $\pi\pi$ system. A zero effective range approximation for the S-wave leads to a pole of the S-matrix which is located on the second Riemann sheet at (1012 ± 6) − i(16 ± 5) MeV. (auth)

25969 DIRECT CHANNEL EFFECTS IN NONDIFFRACTIVE SCATTERING. Matthews, J. A. J. (Stanford Univ., CA). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 13, 188-205(1973).

From international conference on $\pi-\pi$ scattering and associated topics; Tallahassee, Florida (28 Mar 1973).

Direct channel or absorption effects are first considered for π exchange reactions, and in particular for πN → ρN. The discussion is then restricted to nondiffractive pseudoscalar-meson

baryon scattering reactions, where only two helicity amplitudes define the scattering process. The 6 GeV/c πp amplitude analyses are reviewed; energy dependences of various features of the data are then studied to obtain a qualitative understanding of the energy trends of the helicity amplitudes. The relation of these results to $\pi\pi$ analyses is discussed. (auth)

25970 RELATIVE PHASES OF SINGLE PION PRODUCTION AMPLITUDES. Gutay, L. J. (Purdue Univ., Lafayette, IN); Vasavada, K. V. AIP (Amer. Inst. Phys.) Conf. Proc.; No. 13, 255-259(1973).

From international conference on $\pi-\pi$ scattering and associated topics; Tallahassee, Florida (28 Mar 1973).

Recently it has been claimed that the coherent phase hypothesis of the P wave amplitudes in ρ^0 production is wrong. It is shown that this conclusion is not valid. (auth)

25971 $\pi^-p \to \pi^-\pi^+n$ AMPLITUDE ANALYSIS AND EXTRAPOLATION TO THE π EXCHANGE POLE. Estabrooks, P.; Martin, A. D. (CERN, Geneva). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 13, 357-361(1973).

From international conference on $\pi-\pi$ scattering and associated topics; Tallahassee, Florida (28 Mar 1973).

The $\pi^-p \to \pi^-\pi^+n$ amplitudes are solved analytically in the ρ region at 17.2 GeV/c and find two acceptable solutions. The extrapolation of s and t channel amplitudes to the π pole is discussed and it is concluded that the former should be used for $\pi\pi$ phase shift analyses. (auth)

Strong (Baryon No. ≥ 2)

Refer also to abstracts 26104 and 26254.

25972 ENERGY-INDEPENDENCE DISTRIBUTION OF FIREBALLS AND AN EXPLICIT K. N. O. FUNCTION. Levy, D. (CEN de Saclay, Gif-sur-Yvette, France). Nucl. Phys., B59: No. 2, 583-588(1973).

A model is presented in which the average number (c) of fireballs in high-multiplicity reactions is constant with energy. It is shown that this model leads to the K. N. O. scaling law. An explicit form of the K. N. O. function is given for the case where the fireballs are distributed according to a Poisson law. Agreement with experiment is perfect with (c) being our only parameter. (auth)

25973 INVESTIGATION OF UNITARITY AT ISR ENERGIES. Sakai, N.; White, J. N. J. (Max-Planck-Institut fuer Physik and Astrophysik, Munich). Nucl. Phys., B59: No. 2, 511-524(1973).

The unitarity equation in impact-parameter space is analyzed using recent ISR data (at $s = 930$ GeV^2) on σ_T, $d\sigma/dt$ (elastic) and $d^2\sigma/dtdM^2$ (diffractive) as input. The assumption of s-channel helicity conservation for the diffractive process leads to a diffractive overlap function which is central. Unitarity then restricts single diffraction to satisfy $2\sigma_d \leq 5.8$ mb. The assumption of t-channel helicity conservation, on the other hand, gives the interesting result that diffractive processes are peripheral in b-space if the diffractively produced state has high spin. Unitarity in this case gives no significant bound on $2\sigma_d$. For both cases, nondiffractive processes are peripheral. (auth)

25974 FIT TO THE N-PARTICLE CROSS SECTIONS IN A MODEL WITH SU(3) SINGLET UNCORRELATED FIREBALLS. Hayot, F.; Morel, A. (CEN de Saclay, Gif-sur-Yvette, France). Nucl. Phys., B59: No. 2, 493-510(1973).

The cross sections σ_{n_c} for n_c charged particle production in high energy pp scattering are reproduced, and thus quasi-scaling for the KNO function $\langle n_c\rangle\sigma_{n_c}/\sigma_{inel}$ over the energy range 50–300 GeV/c is obtained. This result is obtained in a model in which the multiperipheral secondaries originate from a chain of uncorrelated fireballs, decaying into pairs of octet vector mesons in an SU(3) singlet state, and the secondaries of diffractive type follow a Poisson distribution. At each energy, the average $\langle n_c\rangle$ of charged secondaries is taken from experiment. Then all cross sections are obtained using only one free parameter. (auth)

25975 CORRELATION INTEGRALS FOR CHARGED AND NEUTRAL PIONS IN INCLUSIVE PRODUCTION AND THE TWO-COMPONENT PICTURE. Fialkowski, K. (Jagellonian Univ., Krakow). Acta Phys. Pol.; B4: No. 4, 545-560(1973).

The existing data on multiplicity distribution of charged and neutral pions produced in high energy interactions are analyzed in terms of correlation integrals. The two-component picture of particle production is used to explain the data. The model is shown to describe correctly the two- and three-particle correlations between charged pions as well as the two-particle correlations between charged and neutral pions. The possible detailed versions of the model differing at highest energies are discussed. (auth)

25976 TRANSVERSE-MOMENTUM DISTRIBUTION IN MULTIPERIPHERAL MODELS. Boldrighini, C. (Univ., Rome); Lusanna, L. Lett. Nuovo Cim.; 7: No. 16, 833-840(18 Aug 1973).

It is shown that a general multiperipheral model with a universal exponential cut-off in invariant momentum transfers accounts for many features of single particle transverse spectra. The model is applied to the process $p + p \to \pi + X$. (LBS)

25977 PROTON LEADING-PARTICLE SPECTRUM AT ACCELERATOR ENERGIES. Capella, A.; Hoegaasen, H.; Petersson, B. (Laboratoire de Physique Theorique et Particules Elementaires, Orsay, France). Nuovo Cim.; 17A: No. 1, 23-36 (1 Sep 1973).

The proton spectrum in p-p inclusive reactions is described as being made up of two components: one of a quasi-diffractive type, and one analogous to the spectrum of a produced particle. With an exponential form $\exp[as'/s]$ (where s' is the square of the missing mass) for the second component, a remarkably good fit is obtained to the experimental points at 14, 19 and 24 GeV/c in the interval $0.9 \geq x^0 \geq 0.5$ (where $x^0 = 1 - s'/s$) and $|t| < 1$ (GeV/c)^2. The interpretation of this spectrum with a conventional RRP term is shown to be difficult. (auth)

25978 NONMESONIC DECAYS OF HEAVY HYPERFRAGMENTS. Goel, S. P. (Kurukshetra Univ., India); Lokanathan, S.; Prakash, Y. Nuovo Cim.; 17A: No. 1, 7-22(1 Sep 1973).

The nonmesonic decays of heavy hyperfragments of mass A = 20, 40, 60, 80 and 100 are studied through Monte Carlo simulation. The complete decay process including the initial ΛN interaction, the nuclear cascade and the nuclear evaporation is simulated. Information is obtained on the characteristics of the decay star. An attempt is made to infer the mass region of the decaying hyperfragments from the prong distribution of the decay star. It is inferred that the neutron-to-proton stimulation ratio for the heavy hyperfragments may have any value ranging from 1 to 9. (auth)

25979 IMPLICATION OF THE IMPACT PICTURE ON MULTIPLICITY, INCLUSIVE DISTRIBUTION, AND PRODUCTION PROCESSES. Cheng, H. (Massachusetts Inst. of Tech., Cambridge); Wu, T. T. Phys. Lett.; 45B: No. 4, 367-370(6 Aug 1973).

It is predicted that both the average multiplicity and the inclusive distribution for pionization products increase like a positive power of s times a power of ln s. Thus scaling is strongly violated. An experiment involving a fragmentation product is proposed. (auth)

25980 PION PRODUCTION AT LARGE TRANSVERSE MOMENTUM. Landshoff, P. V.; Polkinghorne, J. C. (Cambridge Univ., Eng.). Phys. Lett.; 45B: No. 4, 361-362(6 Aug 1973).

A constituent interchange model is used to give a natural explanation of the observed energy dependence of ISR data for π^0 production at 90°. It is predicted that at large fixed p_T and sufficiently high energy the cross section will become constant, with a p_T dependence of $(p_T^2)^{-2\cdot5}$. It is also tentatively suggested that e^+e^- annihilation structure function νW_2 should behave like $\omega^{-1\cdot5}$ near $\omega = 0$. (auth)

25981 LANDAU'S HYDRODYNAMICAL MODEL AND THE INCLUSIVE PION SPECTRUM FROM 24 TO 1500 GEV/C. Cooper, F.; Schonberg, E. (Belfer Graduate School of Science, Yeshiva University, New York, New York, 10033). Phys. Rev. Lett. 30: No. 18, 880-883 (30 Apr 1973).

We use a refinement of Landau's hydrodynamical model of particle production to predict the spectra of pions in the inclusive reaction $p+p \to \pi^\pm$+anything at high energies. With one overall constant obtained by normalizing the total multiplicity at one energy, we find that both the transverse and longitudinal momentum spectra predicted by the theory are in good agreement with the existing data. (auth)

25982 ESTIMATE OF THE MAGNITUDE OF TRIPLE-POMERANCHUKON COUPLING FROM THE OBSERVED ENERGY DEPENDENCE OF TOTAL AND ELASTIC PP CROSS SECTIONS. Chew, G. F. (Department of Physics and Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). Phys. Rev. D 7: No. 11, 3525-3528 (1 June 1973).

The measured total and elastic pp cross sections are used to give an estimate, to within a factor 2, of triple-Pomeranchukon coupling. The assumption underlying the estimate is that single-fireball formation is asymptotically controlled by an isolated Regge pole. (auth)

25983 SYMMETRY-BREAKING EFFECTS ON SINGULARITIES OF MULTICHANNEL AMPLITUDES NEAR THRESHOLDS. Curiale, J.; MacDowell, S. W. (Physics Department, Yale University, New Haven, Connecticut 06520). Phys. Rev. D 7: No. 11, 3461-3471 (1 June 1973).

The effects of the breaking of an internal symmetry on the singularities of the scattering matrix, especially near thresholds, is

discussed in terms of the K-matrix formalism. It is shown that, in first order in the symmetry-breaking coupling constant, the K matrix transforms like the symmetry-breaking Hamiltonian. This result provides a justification for the Gell-Mann-Okubo mass formula for narrow resonances with nonzero orbital angular momentum. The position of poles in different sheets of the energy Riemann surface and their displacement with the symmetry-breaking parameter is investigated in detail, particularly for s waves. The specific case of baryon-baryon scattering in the triplet s-d states is discussed using a potential model with broken SU_3 symmetry. On the basis of information from low-energy np scattering and Λp final-state interaction we suggest that a resonance probably exists in the I = 1 ΞN system, below the ΣΛ threshold. The Gell-Mann-Okubo mass formula would have placed the resonance close to the ΣΣ threshold. (auth)

25984 LOW-ENERGY Σ^-D SCATTERING WITH EXPLICIT AND IMPLICIT Λ CHANNEL. Schick, L. H. (Department of Physics and Astronomy, University of Wyoming, Laramie, Wyoming 82070). Phys. Rev. D 7: No. 11, 3309-3314 (1 June 1973).

A Faddeev formalism and two-body S-wave central separable potentials are used to calculate Σ^-d quartet elastic and reaction cross sections for Σ^-d lab momentum in the range 30-150 MeV/c. A three-channel (Σ^-p, Σ^0n, Λn) hyperon-nucleon potential is used, Σ^-d cross sections being calculated with both an explicit and an implicit treatment of the Λ channel. The implicit Λ channel approximation is found to be excellent when the Σ^-n interaction is repulsive, but breaks down in part for an attractive Σ^-n interaction. (auth)

25985 APPROACH TO SCALING IN THE SCATTERING OF COMPOSITE SYSTEMS. Fishbane, P. M.; Trefil, J. S. (Univ. of Virginia, Charlottesville). Phys. Lett.; 45B: No. 5, 503-506 (20 Aug 1973).

It is shown that scattering cross sections for composite systems approach a scaling limit when multiple scattering effects are taken into account, provided that the scattering of their constituents scales. Primary collisions between constituents are assumed to be multiperipheral-like. (auth)

25986 ISR RISING CROSS SECTION AND FINITE ENERGY EFFECTS IN THE POMERANCHUK MECHANISM. Craigie, N. S. (Univ., Hamburg); Preparata, G. Phys. Lett.; 45B: No. 5, 487-489(20 Aug 1973).

It is suggested that the trends in the high energy cross sections at small t can be understood in the framework for the Pomeranchuk mechanism proposed by Gribov. (auth)

25987 DETERMINATION OF THE TRIPLE-POMERON COUPLING FROM THE ISR DATA. Kaidalov, A. B.; Khoze, V. A.; Pirogov, Yu. F.; Ter-Isaakyan, N. L. (Leningrad Nuclear Physics Inst.). Phys. Lett.; 45B: No. 5, 493-496(20 Aug 1973).

The inclusive hadron spectra in the high-energy pp collisions near the kinematic boundary are described within the framework of the triple-Regge model with scaling terms only. The magnitude of the triple-Pomeron vertex is determined and the role of the latter in different approaches to the description of strong interactions asymptotics is discussed. (auth)

25988 MULTIPERIPHERAL CALCULATION OF THE INCLUSIVE π^+ AND π^- SPECTRUM IN HIGH ENERGY PROTON-PROTON COLLISIONS. Jolley, D. K. Salt Lake City, UT; Univ. of Utah (1973). 163p. University Microfilms Order No. 73-21,369.

Thesis (Ph. D.).

A multiperipheral calculation of the inclusive π^+ and π^- differential cross sections for high energy proton-proton collisions is made. The calculation of the many graphs involved in these processes is done by summing the graphs into two main graphs which correspond to pions produced near the end of the chain and those produced in the middle of the chain. With very few assumptions concerning the off-mass shell behavior of the virtual pions in the graphs, a good fit with experimental data is achieved. The $\pi^+\pi^-$ charge ratio and the regions of dominance of the two graphs both agree well with experimental data over a wide range of conditions. The predicted "plateau" in the plot of the invariant differential cross section versus rapidity, and the predicted scaling behavior of the graphs are also seen. The major weaknesses of the model are a traverse momentum dependence of the differential cross-sections which falls off slightly slower than experiment indicates and the necessity of using a π-π elastic cross-section which is two or three times larger than what is normally predicted. (auth)

25989 RELATIVISTIC PROPAGATORS FOR $\pi-\pi$ RESONANCES AND THE N-N INTERACTION. Nack, M. L.; Ueda, T.; Green, A. E. S. (Univ. of Florida, Gainesville). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 13, 332-336(1973).

From international conference on $\pi-\pi$ scattering and associated topics; Tallahassee, Florida (28 Mar 1973).

A relativistic resonance propagator is presented whose form is designed to fit the full S-matrix and therefore the corresponding phase shift data, and to also satisfy a threshold scattering length relationship. This model is fitted to several recently reported $\pi-\pi$ S and P waves phase shifts solutions. It is found that the corresponding mass spectral functions lead to substantially different $\pi-\pi$ system exchange contributions to the N-N interaction. (auth)

25990 OVERVIEW. Jackson, J. D. (National Accelerator Lab., Batavia, IL). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 12, 404-439(1973).

From conference on high energy particle interactions; Nashville, TN (26 Mar 1973).

Some comments and observations are made concerning the subject matter of the Vanderbilt conference: I. The topological cross sections for p-p and π-p interactions—the two-component picture, quark model expectations, and KNO scaling; II. Inclusive processes—the energy dependences of the different cross sections, the central region and Landau's hydrodynamic model as an alternative to the conventional view; III. Total and elastic cross sections—the rising total cross section, the slope parameter and the ratio of real to imaginary part, asymptotic expectations, the scattering at moderate |t| values. In addition, some miscellaneous remarks are made on antideuteron production, inelastic proton spectra, phenomena at large transverse momenta, and speculations on future developments. (auth)

Particle Invariance Principles and Symmetries

General

25991 ASYMPTOTIC BEHAVIOR OF THE UNITARY REPRESENTATIONS OF THE POINCARE GROUP. Petrov, A. D. (Inst. of Physics, Sofia). Compt. Rend. Acad. Bulg. Sci.; 26: No. 3, 307-309(1973).

It is shown that some of the asymptotic properties of the unitary representations of the Poincare group are an immediate consequence of the structure of the corresponding Lie algebra. (LBS)

25992 PROPERTIES OF THE GREEN'S FUNCTION UNDER FINITE TRANSFORMATIONS OF A SOFT-BROKEN-SYMMETRY GROUP. Nobili, R. (Univ., Padua). Nuovo Cim., 17A: No. 1, 171-188(1 Sep 1973).

Transformation properties of Green's functions are studied when, under rather general hypotheses, the local fields are subjected to finite transformations of a continuous group of soft broken symmetries. A perturbative series is found and its convergence conditions are discussed. Also the limiting case of spontaneously broken symmetries is considered to complete the picture. As an application transformation properties of Green's functions under the dilatation group are considered. Finally a method is given to represent a general Green's function as an expansion in series of dilatation-invariant terms; the related mathematical difficulties are also discussed. (auth)

25993 NONLINEAR GROUP ACTION. Smooth Action of Compact Lie Groups on Manifolds. Michel, L. (Institut des Hautes Etudes Scientifiques, Bures-sur-Yvette, France). pp 133-150 of Statistical Mechanics and Field Theory. Sen, R. N. (ed.). New York; John Wiley and Sons, Inc. (1972).

Linear representations of groups is a particular case of group action which is well known to physicists. The aim of these lectures is to give the basic concepts for general group action. The action of (abstract) groups on sets is considered. The homogeneous spaces of a given group is studied. Continuous actions of topological groups on topological spaces are discussed. The last section gives some results on the important particular case of smooth action of compact Lie groups on manifolds. For lack of time, no physical applications are given, but some references are provided. (auth)

25994 SYMMETRIES, CURRENTS, AND INFINITESIMAL GENERATORS. Reeh, H. (Max-Planck-Institut fuer Physik und Astrophysik, Munich). pp 151-167 of Statistical Mechanics and Field Theory. Sen, R. N. (ed.). New York; John Wiley and Sons, Inc. (1972).

Recent work concerning spontaneous breakdown of symmetries and the connection between conserved local currents and infinitesimal generators of symmetry transformations, including dilation and conformal transformations is reviewed. (auth)

Applications (Electromagnetic and Weak)

Refer also to abstracts 25736, 25739, and 25851.

25995 (COO-2271-18) SPONTANEOUS T VIOLATION. Lee, T. D. (Columbia Univ., New York). 1973. 24p. Dep. NTIS $3.25.

Two fundamental questions are examined: (1) Why should CP symmetry be violated ? and (2) Why should the violation be so small? A general class of theories is examined in which the total Lagrangian is assumed to satisfy (a) invariance under CP and T, (b) renormalizability, and (c) invariance under certain weak and electromagnetic gauge transformations. The mechanism of spontaneous T violation is discussed. (LBS)

25996 ALGEBRAIC STRUCTURE OF CHIRAL CHARGES AND THE MIXING OPERATOR; A PREDICTION FOR f_K/f_π. Nicola, F. (Univ., L'Aquila, Italy). Lett. Nuovo Cim.; 7: No. 16, 789-792(18 Aug 1973).

It is shown how some algebraic properties of the chiral charges together with a mixing operator, recently derived by Gilman and Kugler, are present also in a field-independent model for the chiral charges proposed by Buccella, Savoy, and Celeghini. A satisfactory value for the ratio f_K/f_π is also derived, starting from the SU(3) symmetry breaking mechanism for the vector and axial charges. (LBS)

25997 INTERNAL SYMMETRIES AND AN ANALYSIS OF BILOCAL OPERATORS WITH PARTONS WITH THREE-TRIPLET CURRENTS. Choudhury, D. K. (Oxford Univ.). Nuovo Cim.; 17A: No. 1, 189-214(1 Sep 1973).

Three-triplet quark currents for the weak and electromagnetic interactions are examined in the context of different internal-symmetry groups. Parton models constructed out of these currents are then applied to investigate the usual deep inelastic region of $eN \to \mu X$ and $(\nu,\bar{\nu})N \to \mu X$. The relevant bilocal current algebra on the light-cone is examined and correspondence with parton models demonstrated. To test these hypotheses of internal symmetries and the full bilocal current algebra based on them, the semi-inclusive processes $lH \to l'(l^+l^-)X$ (l, l' are leptons, (l^+l^-) the lepton pair and H is any hadron target) are studied in a generalized Bjorken limit. In particular, sum rules are derived to test the symmetries in the process $eN \to e\mu^+\mu^-X$. The implications of these hypotheses on $\pi^0 \to 2\gamma$, $e^+e^- \to$ hadrons, $e^+e^- \to (p,n)X$, and deep inelastic $\gamma p \to (\mu^+\mu^-)X$ are also discussed. (auth)

25998 SOME CONSEQUENCES OF A MODEL BASED ON THE GELL-MANN HYPERWEAK THEORY OF CP NONCONSERVATION. McElhaney, R. (Department of Physics and Astronomy, University of Hawaii, Honolulu, Hawaii 96822); Tuan, S. F. Phys. Rev. D 7: No. 11, 3503-3512 (1 June 1973).

We propose a simple model which parameterizes the main features of a hyperweak-type theory due to Gell-Mann in which the source of CP nonconservation is attributed to strongly interacting $X^\pm$ particles (sthenons) which, however, have no strong interactions with the normal hadrons. The model suggests that it is not unreasonable to expect CP effects at the level of (α/π) in amplitude in muon decay, though (contrary to earlier expectation) CP effects are negligible in neutrino production of these X particles when they are identified with the charged intermediate vector boson of weak interactions. (auth)

25999 $SU(3) \times S(3)$ OF CURRENTS, $SU_W(6)$ OF CONSTITUENTS, AND ELECTROMAGNETIC DECAYS. Love, A.; Nanopoulos, D. V. (Univ. of Sussex, Eng.). Phys. Lett.; 45B: No. 5, 507-509(20 Aug 1973).

A discussion is given of how far the good results of $SU_W(6)$ for electromagnetic decays can be recovered from the transformation between "current quarks" and "constituent quarks," and the bad results avoided. (auth)

Applications (Strong)

Refer also to abstracts 25893, 25958, and 25983.

26000 BROKEN CONFORMAL SYMMETRY. I. The Hadron Spectrum. Koevesi-Domokos, S.; Yunn, B. C.; Domokos, G. (Johns Hopkins Univ., Baltimore). Nuovo Cim., 17A: No. 1, 103-124(1 Sep 1973).

The breaking of the asymptotic conformal symmetry of strong interactions is investigated. It is assumed that the symmetry is broken by the nonvanishing vacuum expectation value of a scalar field. The first-order symmetry-breaking term in the two-point function is completely determined by the conformally invariant limit of the theory. The model predicts families of almost linear Regge trajectories. It is predicted that the ratio of total widths to masses of resonances is—approximately—a universal constant. Comparison with baryon resonances shows reasonably good agreement with the prediction. (auth)

26001 EXPLICIT AND SPONTANEOUS CHIRAL-SYMMETRY BREAKING IN TERMS OF ASYMPTOTIC FIELDS. Bessler, L. (Department of Physics, Queen Mary College, University of London, Mile End Road, London E1 4NS, England); Rest, J.; Welling, D. Phys. Rev. D 7: No. 12, 3818-3820 (15 June 1973).

The Hamiltonian density for asymptotic scalar- and pseudoscalar-meson fields is analyzed in the presence of explicit and spontaneous breaking of chiral SU(3) x SU(3) symmetry down to $SU_I(2) \times U_Y(1)$. It is found that the representations $(3,3^*) + (3^*,3)$, $(1,8) + (8,1)$, $(6,6^*) + (6^*,6)$, and (8,8) (and the singlet) are all present. The connection of the results with earlier work is discussed. (auth)

26002 SYMMETRY BREAKING IN THE MESON-BARYON SYSTEM AND TRIANGULAR REPRESENTATIONS OF CHIRAL SU(3). McDonald, A. (Department of Theoretical Physics, Oxford University, England); Rosen, S. P. Phys. Rev. D 7: No. 12, 3686-3689 (15 June 1973).

We assume that the chiral-symmetry-breaking Lagrangian is an admixture of SU(3) singlet and octet components contained in a single representation $(m, \bar{m}) + (\bar{m}, m)$ of $SU(3) \times SU(3)$. If we restrict ourselves to the case in which (m) is any triangular representation of SU(3), we find that, except for the triplet, all such symmetry-breaking Lagrangians are inconsistent with present data on meson-baryon σ terms. Thus the only irreducible representation that may be consistent is the $(3,\bar{3}) + (\bar{3},3)$. (auth)

26003 FURTHER EXPLORATION OF SU(3) SYMMETRY AND EXCHANGE DEGENERACY OF BARYON REGGE RESIDUES. Kayser, B. (National Accelerator Laboratory, P. O. Box 500, Batavia, Illinois 60510). Phys. Rev. D 7: No. 11, 3358-3367 (1 June 1973).

By working at wrong-signature nonsense points where background Regge poles vanish, evidence for the SU(3) symmetry of the residue of the γ (Reggeized $(3/2)^-$) exchanges, and new confirmations of the SU(3) symmetry of the residue of the α (Reggeized $(1/2)^+$) exchanges, are obtained from backward meson–baryon cross sections. Then, taking the SU(3) symmetry properties for granted, it is shown that the gross features of various backward angular distributions imply that exchange degeneracy of the baryon Regge residues is broken. Further evidence of the breaking is found in the apparent violation of a constraint in whose derivation not even Regge exchanges thought to be small are neglected. Quantitative estimates of the breaking show that residues which should be equal differ by factors of between 2 and 5. An apparent very large violation of SU(3) which cannot be attributed to exchange-degeneracy breaking is noted, and its possible explanation speculated upon. Experiments which would be relevant are discussed. (auth)

Scattering Theory

Refer also to abstracts 25682, 25683, 25690, 25700, 25809, 25810, 25983, 26267, and 26442.

26004 (IFA-FT-95-1972) OPTIMAL ANALYTIC EXTRAPOLATION FOR THE SCATTERING AMPLITUDE FROM CUTS TO INTERIOR POINTS. Ciulli, S.; Nenciu, G. (Gosudarstvennyi Komitet po Ispol'Zovaniyu Atomnoi Energii SSSR, Obninsk. Fiziko-Energeticheskii Institut). 1972. 63p. INIS.

Given a data function together with an error corridor for the scattering amplitude along some finite part of the cuts, one can construct effectively the whole set of analytic functions ("admissible amplitudes"), compatible with these conditions and bounded by a certain number M on the remaining part of the cuts. Depending on the actual value of an important constant ϵ_0 computed from the data functions from ϵ and from the bound M, this set may be void. If not, in every point of the cut plane the set of values of the admissible amplitudes fills densely a circle; explicit formulae are given for its radius $\eta(z)$ and center $f(z)$, the latter being the best possible estimate for the whole set. In contrast to the linear extrapolation obtained by Poisson weighted dispersion relations, here no linear functional method was used. (auth)

26005 EQUATIONS OF THE AMPLITUDES IN DIRECT AND INVERSE SCATTERING PROBLEMS. Amirkhanov, I. V.; Grechko, V. E.; Dement'ev, R. K. (Moscow State Univ.). Acta Phys. Pol.; B4: No. 4, 449-460(1973). (In Russian).

New equations for the nonrelativistic scattering amplitudes in the general type of reactions and for scattering amplitudes of the two relativistic particles are obtained. These equations are analogous to those of the phase functions method. The obtained equations permit the inverse scattering problem to be solved on the basis of the known data on the total cross sections. (auth)

26006 INDEFINITELY RISING TRAJECTORIES. Becherrawy, T. (Lebanese Univ. Hadath, Choueifat). Lett. Nuovo Cim.; 7: No. 17, 867-870(25 Aug 1973).

The asymptotic behavior of indefinitely rising Regge trajectories is re-examined, and a more general derivation of the result is given. Also other relativistic calculations with regard to this asymptotic behavior are discussed. (JFP)

26007 ABSORPTIVE CORRECTIONS TO EXCHANGE REACTIONS IN POTENTIAL SCATTERING. Kamal, A. N. (Univ. of Alberta, Edmonton). Nucl. Phys.; B59: No. 2, 477-492(1973).

Absorption prescriptions are derived for exchange reactions in potential scattering using the eikonal approximation. (auth)

26008 DERIVATION OF THE MITRA THREE-BODY MODEL FROM THE FADDEEV THEORY. Vanzani, V. (Univ., Padua). Nuovo Cim.; 16A: No. 3, 449-461(1 Aug 1973).

The Mitra three-body model is reformulated in the context of the Faddeev theory. A mathematical relationship between the Mitra spectator functions and the Faddeev scattering wave function components, in the separable potential approximation, is established. Some questions related to the interpretation of the Mitra formalism in terms of generalized optical wave functions are discussed and some new insight into the problems involved in the distorted-wave description of direct nuclear reactions is obtained. (auth)

26009 INTEGRAL EQUATION METHOD FOR THE ANALYTIC CONTINUATION OF THE S-MATRIX. Minelli, T. A.; Vitturi, A. (Univ., Padua). Nuovo Cim.; 16A: No. 3, 462-472(1 Aug 1973).

It is shown here that the Fredholm method can be generalized to the solution of an integral equation relating the analytic continuation of the Bloch Green's function at different energies; by this equation the analytic continuation of the S-matrix for cut-off potentials can be obtained. The analytical properties of the Fredholm determinant of our problem are pointed out, and the equivalent of the Jost and Pais relation is deduced. (auth)

26010 HIGH ENERGY LIMIT IN POTENTIAL SCATTERING. Martin, P. A. (Univ. of Colorado, Boulder). Nuovo Cim.; 17A: No. 1, 73-95(1 Sep 1973).

The scattering at high energy of a relativistic spinless particle by a (complex) potential is studied. It is shown that the phase shift, in the impact-parameter representation, becomes energy independent at high energy. It is proved that, consequently, both the elastic and inelastic total cross sections approach nonzero limits as the energy goes to infinity. (auth)

26011 IMPACT PARAMETER DESCRIPTION OF MULTIPARTICLE AND ELASTIC SCATTERING. Henyey, F. S. (Univ. of Michigan, Ann Arbor). Phys. Lett.; 45B: No. 4, 363-366 (6 Aug 1973).

Impact parameter variables are defined for a multiparticle production process. The equation of unitarity for elastic scattering is written at high energy in terms of these variables. The overall impact parameter can be expressed in terms of the impact parameters of all the produced particles. The unitarity equation becomes an "optical theorem" at each impact parameter—diffractive scattering is given by beam depletion. These features allow this technique to give a much clearer interpretation of unitarity in any model than has therefore been possible. This technique can be used to study existing models, and to suggest new ones. (auth)

26012 ASYMPTOTIC BEHAVIOR OF THE REAL PART OF THE SCATTERING AMPLITUDE AT $T \neq 0$. Martin, A. (CERN, Geneva). Lett. Nuovo Cim.; 7: No. 16, 811-812(18 Aug 1973).

A formula is derived for the ratio of the real to the imaginary part of the scattering amplitude at $t \neq 0$. It is noted that, if the imaginary part of the scattering amplitude has zeros in the physical region, the contribution of the real part will make the cross section nonvanishing. (LBS)

26013 GHOST-FREE STRING PICTURE OF VENEZIANO MODEL. Gervais, J. (Department of Physics, City College of the City University of New York, New York, New York, 10031); Sakita, B. Phys. Rev. Lett. 30: No. 15, 716-719 (9 Apr 1973).

The recently proposed Lagrangian of a free string is quantized by means of path integrals. It is shown how Veneziano amplitudes are obtained in this picture by coupling the string with external sources. (auth)

26014 FORMAL SCATTERING THEORY WITH SHADOW STATES. Richard, J. L. (Center for Particle Theory, University of Texas at Austin, Austin, Texas 78712). Phys. Rev. D 7: No. 12, 3617-3629 (15 June 1973).

Within the framework of quantum field theory with indefinite metric, a formal scattering theory is presented in which the concept for shadow states introduced by Sudarshan has been used. An expression for the transition amplitude is given which has the properties of covariance and unitarity on the physical states. In an explicit example, it is shown that only physical discontinuities have to be expected. (auth)

26015 TRACE FORMULAS AND SINGULARITIES IN SCATTERING MATRIX FOR A SYSTEM OF THREE ONE-DIMENSIONAL PARTICLES. The Third Group Integral. Buslaev, V. S. (Leningrad State Univ.). Teor. Mat. Fiz.; 16: No. 2, 247-259(Aug 1973). (In Russian).

A new expression for the third group integral is obtained in terms of the two- and three-particle scattering matrices. For the Bose- and Fermi-statistics the result is essentially simpler than for the Boltzmann statistics. The compact description of singularities of the three-particle scattering matrix is obtained. The particles are supposed to be one-dimensional. (auth)

26016 SPIN STATES IN DUAL MODELS WITH FERMIONS. Ioffe, M. V.; Manida, S. N. (Leningrad State Univ.). Teor. Mat. Fiz.; 16: No. 2, 244-232(Aug 1973). (In Russian).

Intermediate states of meson and fermion channels of the four-particle Neveu–Schwarz dual amplitude for definite mass and spin values are constructed within the operator formalism. The explicit expression for the state norm is obtained. (auth)

26017 ADIABATIC DEFINITION OF THE SCATTERING MATRIX IN THE FORMALISM OF L-FUNCTIONALS. Tyrpkin, Yu. S. Teor. Mat. Fiz.; 16: No. 2, 169-177(Aug 1973). (In Russian).

A definition of renormalized S-matrix is given in a formalism based on representation of states by means of positive functionals on the algebra of observables. (auth)

26018 VARIATIONAL PRINCIPLE FOR THE MATRIX ELEMENTS OF THE S-MATRIX. Labzovskii, L. N. (Leningrad State Univ.). Teor. Mat. Fiz.; 16: No. 2, 178-185(Aug 1973). (In Russian).

A variational principle is formulated for the matrix elements of the S-matrix in quantum electrodynamics. This principle may be used in approximate calculations of the matrix elements, corresponding to the Feynman graphs with one electron line and any number of external photon lines. The second order energy shift in the external electric field is calculated as an example. (auth)

PHYSICS (LOW-TEMPERATURE)

Superfluidity

Refer also to abstract 26029.

26019 EVIDENCE FOR SUPERFLUIDITY IN THE NEWLY FOUND PHASES OF ^{3}He. Alvesalo, T. A.; Anufriyev, Y. D.; Collan, H. K.; Lounasmaa, O. V.; Wennerström, P. (Department of Technical Physics, Helsinki University of Technology, 02150 Ontaniemi, Finland). Phys. Rev. Lett. 30: No. 20, 962-965 (14 May 1973).

The relative viscosity η of liquid ^{3}He has been measured along the melting curve from 10 mK to about 1 mK with a vibrating-string viscometer. As the temperature is reduced, η first increases as expected until the pressure anomaly "A" is reached. The viscosity then starts to decrease, has a discontinuous drop at the pressure anomaly "B," and then continues to diminish rapidly. The lowest measured value of η is 1000 times smaller than that at point A. This must be regarded as strong evidence for superfluidity. (auth)

26020 SECOND-SOUND VELOCITY AND SUPERFLUID DENSITY IN ^{4}He UNDER PRESSURE NEAR T_λ. Greywall, D. S.; Ahlers, G. (Bell Laboratories, Murray Hill, New Jersey 07974). Phys. Rev. A 7: No. 6, 2145-2162 (June 1973).

The velocity of second sound was measured in superfluid ^{4}He between vapor pressure and the melting pressure for $T \geq 1.6$ K. Particular emphasis was given to the temperature region near T_λ with $2 \times 10^{-5} \lesssim \epsilon \equiv 1 - T/T_\lambda(P) \lesssim 10^{-2}$. By using these results, other existing thermodynamic information, and linear two-fluid hydrodynamics, the superfluid fraction, ρ_s/ρ, was determined. The higher-pressure data at small ϵ revealed that ρ_s/ρ along isobars cannot be described by a pure power law in ϵ. Instead, singular corrections to the leading power-law term exist which are much larger than of order ϵ. Therefore, the results were fitted to the expression $\rho_s/\rho = k(P)\,\epsilon^\xi[1 + a(P)\,\epsilon^y]$. They yielded $0.66 \lesssim \xi \lesssim 0.68$ and $0.4 \lesssim y \lesssim 0.6$, independent of the pressure P. These results for the exponents, and the existence of singular corrections, are consistent with scaling, universality, and recent explicit calculations. (auth)

26021 DISSIPATIVE COEFFICIENTS OF SUPERFLUID HELIUM. Maris, H. J. (Department of Physics, Brown University, Providence, Rhode Island 02912). Phys. Rev. A 7: No. 6, 2074-2081 (June 1973).

The linearized hydrodynamic equations for superfluid He^4 are derived starting from the kinetic equations of Khalatnikov. Only the lowest-order dissipative terms are considered. The Boltzmann equation for the phonons and rotons is solved formally by expanding the distribution function in terms of the eigenfunctions of the linearized collision operator. The resulting hydrodynamic equations contain dissipative terms of the form proposed by Landau and Khalatnikov. Formal expressions are given for the viscosities and the thermal kinetic coefficient. Finally, relations which may hold between the dissipative coefficients when the collision operator has special properties are discussed. (auth)

26022 EXCITATIONS IN A BOSE GAS AT FINITE TEMPERATURES. II. RELATION BETWEEN SINGLE-PARTICLE AND DENSITY FLUCTUATIONS. Griffin, A.; Cheung, T. H. (Department of Physics, University of Toronto, Toronto, Ontario, Canada). Phys. Rev. A 7: No. 6, 2086-2095 (June 1973).

By making a systematic analysis of correlation functions in terms of irreducible and reducible parts, Ma and others have developed a dielectric formulation of the dynamics of a condensed Bose system which fully includes the background (or excited) atoms. We show that this formulation quite generally leads to the density and single-particle-correlation functions both having two resonances $\tilde{\omega}_1$ and $\tilde{\omega}_2$ although with different weights. If the condensate $n_0 = 0$, the ω_2 mode only appears in the single-particle spectrum while ω_1 only appears in the density-fluctuation spectrum. For finite values of n_0, these modes are coupled and renormalized to $\tilde{\omega}_1$ and $\tilde{\omega}_2$. As a specific illustration, we use the shielded-potential approximation (SPA) for the reducible self-energies. In this model, we find the free-particle excitations (ω_2) are coupled to the zero-sound density fluctuations (ω_1) through the action of the condensate. In the SPA, the reducible self-energies have a pole at ω_1. The usual Bogoliubov, Hartree-Fock, and ordinary t-matrix approximations involve nonsingular self-energies and hence do not exhibit the $\tilde{\omega}_1$ mode. Experimentally, it appears that the high-frequency $\tilde{\omega}_2$ mode has never been detected, but this is probably owing to the fact that it is strongly damped as a result of its coupling to the zero-sound mode. Using the two-fluid hydrodynamic equations, one can argue that at low frequencies the $\tilde{\omega}_1$ excitation corresponds to first sound and the $\tilde{\omega}_2$ excitation corresponds to second sound. Finally, we briefly discuss the possibility of singularities in the irreducible self-energies at high frequencies and the resulting two-roton bound states. (auth)

26023 SUPERFLUIDITY IN A RING. Bloch, F. (Department of Physics, Stanford University, Stanford, California 94305). Phys. Rev. A 7: No. 6, 2187-2192 (June 1973).

The persistent flow of a superfluid in a ring is discussed in terms analogous to those previously used for superconductors. The existence of a phase memory around the ring is shown to be responsible for energy minima with a periodic dependence on the total momentum which is directly related to the quantization of circulation. The general features are illustrated by means of the ideal Bose gas and the model of quasiparticles as examples. (auth)

26024 DISTILLATION OF HELIUM ISOTOPES. Wilkes, W. R. (Monsanto Research Corp., Miamisburg, OH). pp 119-121 of Proceedings of the Fourth International Cryogenic Engineering Conference. Guildford, Eng.; IPC Science and Technology Press Ltd. (1972).

From 4th international cryogenic engineering conference; Eindhoven, Netherlands (24 May 1972). See CONF-720565-.

An improved helium distillation apparatus has been developed incorporating a closed cycle ^{3}He refrigerator operating near 1.5°K to cool the column condenser. As a result of the closed cycle refrigerator, this device is capable of continuous operation for much longer periods of time than earlier models utilizing a pumped ^{4}He bath in an open cycle refrigerator. In addition, lower operating temperatures are now possible, permitting a reduction in the size of the apparatus without a degradation of product quality. Continuous production of 99.95% ^{3}He in ^{4}He has been attained for a period of 24 hours. (auth)

26025 CORRELATION OF THE VAPORIZATION ONSET HEAT FLUX FOR CYLINDERS IN SATURATED LIQUID HELIUM-II. Leonard, A. C. (Royal Military Coll. of Canada, Kingston, Ont.); Clermont, M. A. pp 301-306 of Proceedings of the Fourth International Cryogenic Engineering Conference. Guildford, Eng.; IPC Science and Technology Press Ltd. (1972).

From 4th international cryogenic engineering conference; Eindhoven, Netherlands (24 May 1972). See CONF-720565-.

As the heat flux density to liquid helium-II increases, a critical density is reached and vaporization occurs which severely reduces the heat transport capability. Recent investigations of critical heat flux density for zero net mass flow heat transfer from horizontal cylinders have been extended to temperatures down to about 1°K. The data depart from the Haben et al., theory which has been proposed for temperatures near the λ point. Here the range of validity is extended by modification of the superfluid order parameter effect (ρ_s/ρ), and by accounting for the size effects in terms of the classical natural convection diameter logarithmic dependence. The data are in good agreement with the modified theory for diameters of 0.0025 to 0.32 cm, depths of immersion of 1 to 70 cm, and bath temperatures of 1.1 to 2.173°K. (auth)

26026 CRITICAL HEAT FLUX OF SATURATED AND SUBCOOLED HELIUM-II IN LONG TUBES. Krafft, G. (Kernforschungszentrum, Karlsruhe, Ger.). pp 307-309 of Proceedings of the Fourth International Cryogenic Engineering Conference. Guildford, Eng.; IPC Science and Technology Press Ltd. (1972).

From 4th international cryogenic engineering conference; Eindhoven, Netherlands (24 May 1972). See CONF-720565-.

Heat transport experiments with superfluid helium in 15 to 400 cm long tubes with inner diameters between 0.3 and 1.0 cm show that helium II can be superheated. The critical heat flux density depends on the difference between the maximum superheat temperature and liquid bath temperature as well as the tube length. (auth)

26027 TWO-FLUID ASPECTS OF CONDENSED MATTER. Enz, C. P. (IBM Research Lab., Zurich). pp 91-99 of Statistical Mechanics and Field Theory. Sen, R. N. (ed.). New York; John Wiley and Sons, Inc. (1972).

The close analogy in the hydrodynamics of a wide class of many-body systems characterized by a state with a condensed phase is stressed. These systems are neutral superfluids (liquid helium), superconductors, dielectric crystals, magnetic crystals and nematic liquid crystals. The condensed phase gives rise to a two-fluid description which is physically characterized by its modes of excitation, typically first and second sound. (auth)

26028 GALILEI GROUP AND LANDAU EXCITATIONS. Sen, R. N. (Technion-Israel Inst. of Tech., Haifa). pp 169-186 of Statistical Mechanics and Field Theory. Sen, R. N. (ed.). New York; John Wiley and Sons, Inc. (1972).

The behavior of low-lying excitations in superfluid helium under Galilei transformations is investigated. It appears that the ten-parameter Galilei group acts on them in part linearly, and in part nonlinearly. The latter appears to give rise to the possibility of distinguishing between different inertial frames. In one dimension, the structure is that of a vector bundle over the base space of the boosts. The treatment is elementary and most mathematical ideas are developed ab initio. (auth)

Superconductivity

Refer also to abstracts 25171, 25263, 26027, and 26097.

26029 COHERENT STATES IN MODERN PHYSICS. Gilmore, R. (Univ. of South Florida, Tampa). pp 217-240 of Coherence and Quantum Optics. Mandel, L. (ed.). New York; Plenum Publishing Corp. (1973).

From 3rd Rochester conference on coherence and quantum optics; Rochester, NY (21 Jun 1972).

A model is made of a physical Hamiltonian in which the mathematical operators involved are elements of a Lie algebra. Under these conditions the system state will evolve in time within a vector space which carries a unitary irreducible representation of the Lie group associated with the Lie algebra. R-level atoms, superconducting and superfluid systems, and charged particles in an external field are considered. (JFP)

26030 SUPERCONDUCTIVITY OF LANTHANUM AT PRESSURES UP TO 250 KBAR. Zarubina, O. A. (M. V. Lomonosov Moscow State University). Sov. Phys.-Solid State 14: No. 10, 2497-2499 (Apr 1973).

The dependence of superconducting transition temperature T_c of lanthanum on pressure P was investigated between 0 and 250 kbar. The marked increase of T_c with pressure is interrupted by a change of the slope of $T_c(P)$ curve in the region $P \simeq 70$ kbar; T_c practically ceases to be pressure-dependent in the range 100 to 250 kbar. The results are discussed in the light of current theories. (auth)

26031 SUPERCONDUCTIVITY OF FILMS OF NITRIDES OF SEVERAL METALS AND ALLOYS PREPARED BY THE ELECTROTHERMAL METHOD. Grigor'ev, Yu. M.; Degtyareva, V. F.; Merzhanov, A. G.; Rabin'kin, A. G. (Branch of Institute of Chemical Physics, Academy of Sciences of the USSR, Moscow). Sov. Phys. - Solid State; 14: No. 10, 2626-2627 (Apr 1973).

Superconducting nitride coatings were prepared on wires of Zr, Ta, and Nb (99.95% purity) and of binary and ternary alloys of Nb, Zr, and Ti. The films were synthesized by heating the wires by electric current in an atmosphere of purified N_2. Superconducting transition curves are shown for four of the samples. The results obtained indicated that the synthesis of superconducting nitride films by this method is worth serious consideration. (1 figure) (RWR)

26032 THERMALLY INDUCED FLUX MOTION IN SUPERCONDUCTING TIN. Gupta, A. K.; Farrell, D. E. (Department of Physics, Case Western Reserve University, Cleveland, Ohio 44106). Phys. Rev. B 7: No. 7, 3037-3038 (1 Apr 1973).

Direct evidence is presented for thermally induced flux motion in a superconductor. The method consists of setting up the macroscopic Landau domain structure in a thin single crystal of tin and imposing a temperature gradient along the sample. Motion is monitored with the Sharvin point-contact technique, enabling one to deduce an experimental value for the actual velocity of flux motion. The dependence of this velocity on the applied temperature gradient is found to be in fair agreement with a theory due to Clem. (auth)

26033 FLUCTUATION-INDUCED DIAMAGNETISM ABOVE T_c IN SUPERCONDUCTORS. Gollub, J. P.; Beasley, M. R.; Callarotti, R.; Tinkham, M. (Department of Physics, and Division of Engineering and Applied Physics, Harvard University, Cambridge, Massachusetts 02138). Phys. Rev. B 7: No. 7, 3039-3058 (1 Apr 1973).

The results of an extensive investigation of the enhanced diamagnetism of superconductors above T_c due to thermal fluctuations are presented. Data are reported on a variety of superconductors, including In, Pb, Nb, and several In-Tl and Pb-Tl alloys. The versatile superconducting quantum magnetometer developed for these experiments, which is suitable for a variety of low-temperature magnetic measurements, is also described. The various theoretical treatments of the fluctuation-induced diamagnetism in superconductors are summarized and their predictions compared with experiment. It is found that at high fields [$H \geq H_{c2}(0)$] and high temperatures ($T \sim 2T_c$), the observed diamagnetism deviates markedly from that expected on the basis of the Ginzburg-Landau (GL) theory of superconductivity due to the important contribution of high-energy fluctuations in these regimes. These high-energy fluctuations are not properly described by the simple GL theory. Recent theoretical calculations based on the microscopic Gor'kov theory that attempt to treat these fluctuations properly are found to give a good account of our results for clean materials, once the effects of nonlocal electrodynamics are included, as in the work of Lee and Payne and of Kurkijärvi, Ambegaokar, and Eilenberger. For alloys, however, the theoretical picture is less satisfactory, and it appears possible that even the Gorkov theory may fail to provide an adequate description of high-energy fluctuations in dirty superconductors. (auth)

26034 TEMPERATURE AND THICKNESS DEPENDENCE OF CRITICAL MAGNETIC FIELDS IN LEAD SUPERCONDUCTING FILMS. Di Crescenzo, E.; Indovina, P. L.; Onori, S.; Rogani, A. (Laboratori di Fisica, Istituto Superiore di Sanità, Viale Regina Elena, 299, 00161 Roma, Italy). Phys. Rev. B 7: No. 7, 3058-3065 (1 Apr 1973).

The parallel-field magnetic transitions of the pure Pb films have been determined from microwave absorption measurements as a function of the specimen thickness (700 to 15 000 Å) and of the temperature (3.2 °K to T_c). The parallel critical magnetic field H_{cF} values are in good agreement with the Ginzburg-Landau theory for $d < \sqrt{5}\lambda$ (t,d) and in the limit $d \gg \xi$; a general semiempirical expression for H_{cF} for all the values of the ratio d/λ (t,d) has been determined. The order of the magnetic transition as a function of the specimen thickness and of the temperature has been studied. The surface-superconductivity properties as a function of the thickness have also been investigated and our results are in fairly good agreement with the Saint-James and de Gennes theory. From the data concerning the surface critical magnetic field H_{c3}, it was possible to compute the values of the penetration depth λ (0,d) for any specimen thickness. (auth)

26035 EVIDENCE FOR A SURFACE-PHONON CONTRIBUTION TO THIN-FILM SUPERCONDUCTIVITY: DEPRESSION OF T_C BY NOBLE-GAS OVERLAYERS. Naugle, D. G.; Baker, J. W.; Allen, R. E. (Department of Physics, Texas A&M University, College Station, Texas 77843). Phys. Rev. B 7: No. 7, 3028-3037 (1 Apr 1973).

When care is taken to prevent contamination, the superconducting transition temperatures of thin Al, Sn, Tl, and amorphous-Bi films are depressed by overlayers of Ne or Ar. For a given film, the ratio of the shift in T_c produced by Ar to that produced by Ne is observed to be 1.8. The results can be explained in terms of a modification of the phonon spectrum by the presence of the noble gas. A simple model predicts the observed ratio of the effect of Ar to that of Ne and the relative magnitudes of the shifts for the four different metals. (auth)

26036 COMMENT ON "THERMODYNAMIC PROPERTIES OF SMALL SUPERCONDUCTING GRAINS". Gunther, L. (Department of Physics and Astronomy, Tel-Aviv University and Department of Physics, Technion, Haifa, Israel); Deutscher, G.; Imry, Y. Phys. Rev. B 7: No. 7, 3393-3394 (1 Apr 1973).

A minor inconsistency in a previous derivation of the specific heat (Phys. Rev. B, 6, 1767(1972) is pointed out, and it is shown that the results obtained with the Ginzburg-Landau and generalized Ginzburg-Landau theories should not have been expected to agree with the microscopic calculation. (CES)

26037 MICROWAVE RESIDUAL SURFACE RESISTANCE OF SUPERCONDUCTORS. Rabinowitz, M. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). Phys. Rev. B 7: No. 7, 3402-3403 (1 Apr 1973).

Two distinct models account for the microwave residual surface resistance of superconducting cavities with equally good agreement with the measured temperature and frequency dependence. In presenting his phonon-generation model, Passow claimed that Rabinowitz's fluxoid power-loss model of residual resistance does not fit the experimental data, whereas his does. In fact, the two models have essentially the same temperature and frequency dependence. Furthermore, Passow's phonon-generation model cannot explain the observed sensitivity to details of sample preparation and history while the fluxoid model can. (auth)

26038 FLUCTUATION DIAMAGNETISM IN A "ZERO-DIMENSIONAL" SUPERCONDUCTOR. Buhrman, R. A.; Halperin, W. P. (School of Applied and Engineering Physics, and Laboratory for Atomic and Solid State Physics, Cornell University, Ithaca, New York, 14850). Phys. Rev. Lett. 30: No. 15, 692-695 (9 Apr 1973).

The diamagnetic transition of ensembles of single-crystal aluminum particles with radii less than the superconducting coherence length ξ_0 has been measured over a wide range of temperature, field and average radius. The particles are sufficiently small that the Ginzburg critical region is experimentally accessible. Fluctuation effects are observed inside and outside this critical region. The data agree with recent exact theoretical calculations based on the Ginzburg-Landau functional. (auth)

26039 NEGATIVE DIFFERENTIAL RESISTIVITY IN SUPERCONDUCTORS AT HIGH CURRENT DENSITIES. Huebener, R. P.; Gallus, D. E. (Argonne National Laboratory, Argonne, Illinois, 60439). Appl. Phys. Lett. 22: No. 11, 597-598 (1 June 1973).

In the current-induced resistive state of superconducting strips the voltage shows detailed structure as a function of the transport current. This structure is associated with the re-arrangement within the sample of currents and magnetic fields. We report the observation of current regimes with negative differential resistivity in microstrips of the superconducting alloy Pb-5 at. % Bi. (auth)

26040 RELAXATION TIME OF THE COOPER-PAIR DENSITY IN TIN. Peters, R.; Meissner, H. (Department of Physics and Cryogenics Center, Stevens Institute of Technology, Hoboken, New Jersey, 07030). Phys. Rev. Lett. 30: No. 20, 965-967 (14 May 1973).

The relaxation time τ_R for the density of superconducting electrons to achieve equilibrium with a change in current density has been measured near T_c, using a large, chopped dc and a small continuous rf current. The changeover from $\omega\tau_R \ll 1$ to $\omega\tau_R \gg 1$ has been observed in the frequency range 30 MHz $\leq f \leq$ 900 MHz. In the temperature range $0.95 \leq T/T_c \leq 0.995$, the relaxation time was found to be $\tau_R = 2.6\times10^{-10}(1-T/T_c)^{-1/2}$sec. (auth)

26041 REAL METAL PARAMETERS OF NIOBIUM FROM THE ATTENUATION OF TRANSVERSE ULTRASONIC WAVES. Lea, M. J.; Dobbs, E. R. (Univ. of Lancaster, Eng.). Phys. Lett.; 45A: No. 1, 39-40(27 Aug 1973).

Measurements of the attenuation of shear waves in superconducting niobium along [100] for frequencies from 18 to 105 MHz show that the Fermi-surface deformation parameter for shear strains is large. (auth)

26042 SUPERCONDUCTIVITY IN THE PALLADIUM-HYDROGEN SYSTEM. Skoskiewicz, T. (Inst. of Physical Chemistry, Warsaw). Phys. Status Solidi (b); 59: No. 1, 329-334(1 Sep 1973).

Superconductivity was investigated in palladium hydride samples prepared electrolytically. At H/Pd ratios higher than 0.77, a strong dependence of the superconducting critical temperature on H/Pd ratio was observed. The critical temperature of 6.6°K was found at H/Pd = 0.94. Extrapolation of the experimental data up to H/Pd = 1 gave the critical temperature of stoichiometric PdH of about 11°K. It is shown that the normal residual resistivity of a sample can be used for an estimation of the hydrogen content. The measurements of the electrical resistance in the magnetic field revealed a linear dependence of the critical magnetic field on temperature. Extrapolation of H_c down to T = 0 gave an $H_c(0)$ value equal to 1800 Oe independent of H/Pd. (auth)

26043 AC LOSSES OF NON-IDEAL TYPE II SUPERCONDUCTORS UNDER PARALLEL CONFIGURATIONS OF ELECTRIC CURRENTS AND MAGNETIC FIELDS. Nakayama, Y. (Tokyo Shibaura Electric Co. Ltd., Kawasaki, Japan). pp 133-135 of Proceedings of the Fourth International Cryogenic Engineering Conference. Guildford, Eng.; IPC Science and Technology Press Ltd. (1972).

From 4th international cryogenic engineering conference; Eindhoven, Netherlands (24 May 1972). See CONF-720565-.

It was observed that losses caused by transport ac currents are reduced when longitudinal dc fields are superposed to the wires of Nb-Ti and Nb-Zr. Investigations were made to confirm experimentally the adaptability of the force-free model concerning the losses caused by longitudinal ac fields under the superposition of transport dc currents. Results are presented and the possibility of interpreting the reduction in losses by the force-free model discussed. (auth)

26044 POWER FREQUENCY LOSSES IN SUPERCONDUCTORS. Brankin, P. R.; Rhodes, R. G. (Univ. of Warwick, Coventry, Eng.). pp 136-139 of Proceedings of the Fourth International Cryogenic Engineering Conference. Guildford, Eng.; IPC Science and Technology Press Ltd. (1972).

From 4th international cryogenic engineering conference; Eindhoven, Netherlands (24 May 1972). See CONF-720565-.

Measurements of ac losses in different materials have been reported previously. Further work was undertaken on the ac losses in niobium. Detailed measurements of the effect on the losses of cold-work, interstitial impurities and surface roughness are presented. A model for the loss mechanism was developed and it will be shown that the losses in a wide variety of samples are in quantitative agreement with its predictions. The results enable the required metallurgical characteristics for a cable conductor to be defined. Measurements of the ac losses both above and below H_{c1} in neutron-irradiated, ion-implanted and cold-worked samples were made. These show that cold-working is far more effective in reducing the losses than high doses (10^{20} neutrons/cm^2) of fast neutrons (>1 MeV). Surface currents are shown to be of paramount importance in reducing losses and the possible importance of ion-implantation is discussed. It is shown that in certain samples the losses below H_{c1} are increased by a factor as large as 30 after the material is exposed to a magnetic field in excess of H_{c1}. It is argued that these losses arise from flux trapped within the bulk of the sample and ways in which they may be reduced in a cable conductor are discussed. (auth)

26045 AC MEASUREMENTS IN PURE NIOBIUM AND $Ta_{92}Nb_8$ ALLOY: THE FIELD OF FIRST PENETRATION AND A GENERALIZED LAW OF LOSSES. Furtado, C. S. (Univ. of Coimbra, Portugal). pp 140-142 of Proceedings of the Fourth International Cryogenic Engineering Conference. Guildford, Eng.; IPC Science and Technology Press Ltd. (1972).

From 4th international cryogenic engineering conference; Eindhoven, Netherlands (24 May 1972). See Conf-720565-.

Results are presented of measurements of temperatures of 4.2 K and below in cylinders of pure and high-vacuum-annealed niobium and $Ta_{92}Nb_8$ alloy with different amounts of pinning. Conclusions are drawn with regard to the field of first penetration relative to the lower critical field and it is shown that by choosing appropriate relative coordinates, the ac losses at different temperatures of different superconductors can be fitted approximately to the same curve. (auth)

26046 AC LOSS OF SUPERCONDUCTING Nb-Ti-Zr TERNARY ALLOYS. Kudo, M.; Aihara, K.; Kuroda, K.; Doi, T. (Central Research Lab., Hitachi Ltd., Tokyo). pp 143-145 of Proceedings of the Fourth International Cryogenic Engineering Conference. Guildford, Eng.; IPC Science and Technology Press Ltd. (1972).

From 4th international cryogenic engineering conference; Eindhoven, Netherlands (24 May 1972). See Conf-720565-.

Ac loss and critical current density are studied for Nb-Ti-Zr ternary alloys with different compositions, and a relationship among composition, ac loss and critical current density is discussed. As for copper-clad single-core and fine multicore composites, the ac loss is also examined. (auth)

26047 BEHAVIOUR OF A NIOBIUM SINGLE CRYSTAL IN AC FIELDS. van de Klundert, L. J. M.; Braspenning, N. P. A.; van der Marel, L. C. (Twente Univ. of Tech., Enschede, Netherlands). pp 146-148 of Proceedings of the Fourth International Cryogenic Engineering Conference. Guildford, Eng.; IPC Science and Technology Press Ltd. (1972).

From 4th international cryogenic engineering conference; Eindhoven, Netherlands (24 May 1972. See Conf-720565-.

The ac behavior of a very high purity niobium cylindrical monocrystal was investigated in the temperature range 1.2 to 4.2 K by an inductive method, in the frequency range 1 to 4000 Hz and at amplitudes between 0.02 and 22 Oe. It is shown that the ac behavior can be qualitatively explained when the following material properties are considered: resistivity in the normal region; Hall coefficient; pinning of flux lines; screening current in the surface region. (auth)

26048 LOSSES OF TWISTED SUPERCONDUCTING COMPOSITE CONDUCTORS. Mailfert, A.; Pech, T. (LCIE and LGEP, Fontenay-aux-Roses, France). pp 149-152 of Proceedings of the Fourth International Cryogenic Engineering Conference. Guildford, Eng.; IPC Science and Technology Press Ltd. (1972).

From 4th international cryogenic engineering conference; Eindhoven, Netherlands (24 May 1972). See Conf-720565-.

Loss values were deduced from magnetization measurements carried out on multifilamentary composite conductors of rather conventional structure having filaments larger than 10μm diameter, as well as on recently developed new composites characterized by filament diameters in the 2 to 20μm range. The experimental results are compared with the theoretical. For the calculation of the losses in the matrix the conductance between two neighboring filaments is used, which can be determined by an electrical measurement on the composite under investigation. (auth)

26049 CURRENT AND CURRENT DENSITY DISTRIBUTION IN PARALLEL SUPERCONDUCTING WIRES IN THE MEISSNER STATE. Oswald, D. (AEG-Telefunken Forschunginstitut, Frankfurt am Main). pp 153-155 of Proceedings of the Fourth International Cryogenic Engineering Conference. Guildford, Eng.; IPC Science and Technology Press Ltd. (1972)

From 4th international cryogenic engineering conference; Eindhoven, Netherlands (24 May 1972). See Conf-720565-.

A theoretical analysis is given of current and current density distribution in parallel superconducting wires in the Meissner state as an aid to the understanding of the behavior of superconducting cable cores composed of several conductors in parallel. (auth)

26050 EFFECT OF CU-CLADDING ON MAGNETIC INSTABILITY OF Nb Ti COMPOSITE WIRE. Yasukochi, K.; Ando, T.; Ogasawara, T. (Nihon Univ., Tokyo). pp 156-158 of Proceedings of the Fourth International Cryogenic Engineering Conference. Guildford, Eng.; IPC Science and Technology Press Ltd. (1972)

From 4th international cryogenic engineering conference; Eindhoven, Netherlands (24 May 1972). See Conf-720565–.

In the magnetization process of a short sample of composite wire, the field for stability limit H_s was determined by application of a magnetic disturbance. Various samples with different core diameters (94 to 405 μm) and different copper cladding thicknesses, (25 ~ 75 μm) were tested. The field for stability limit H_{fj} versus temperature T was measured on both copper-clad and bare wires. The value of H_{fj} for bare wires is independent of sample diameter, and the result is in accord with the theory for the adiabatic condition: the magnetic diffusivity $D_m \gtrsim$ the thermal diffusivity D_{th}. H_{fj} of copper-clad wire increases with increasing amounts of copper and, in this case, the adiabatic condition, $D_m \gtrsim D_{th}$, no longer holds, and the observed H_{fj} is explained by the model for $D_m < D_{th}$. From these results, a relation between flux jump free core diameter and copper/superconductor ratio is derived. (auth)

26051 FLUX-FLOW PROPERTIES OF BARE Nb-Ti WIRE. Wipf, S. L.; Soell, M. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). pp 159-164 of Proceedings of the Fourth International Cryogenic Engineering Conference. Guildford, Eng.; IPC Science and Technology Press Ltd. (1972).

From 4th international cryogenic engineering conference; Eindhoven, Netherlands (24 May 1972). See Conf-720565–.

The resistive state of bare Nb–Ti filaments, 6 to 21 μm in diameter, with critical current densities of the order of 10^5 A/cm^2 in a perpendicular magnetic field has been studied. When the critical current is exceeded, a voltage along the specimen is obtained whereat the currents drop by an order of magnitude. These currents establish themselves either by an unstable jump (at low fields, i.e., high critical currents) or via a reversible negative resistance. Two different hypotheses might explain such behavior; the preferred one issues from the flux flow resistivity as found valid for much smaller critical current densities and an analysis of a simple heat transfer. The qualitative results suggest that the resistive superconducting state is realized only in a few hot spots which have temperatures close to T_c and which may not be locally fixed. (auth)

26052 CRITICAL CURRENT DENSITY OF Nb-Ti SUPERCONDUCTOR IN THE TEMPERATURE RANGE 1.9 TO 4.2K. Hanley, P. E.; Biltcliffe, M. N. (Oxford Instrument Co. Ltd., Eng.). pp 224-226 of Proceedings of the Fourth International Cryogenic Engineering Conference. Guildford, Eng.; IPC Science and Technology Press Ltd. (1972).

From 4th international cryogenic engineering conference; Eindhoven, Netherlands (24 May 1972). See Conf-720565–.

The critical current density of commercially available Nb–Ti superconductor has been measured as a function of applied magnetic field up to 10 T, and of temperature in the range 1.9 to 4.2K. It was found that the critical current density showed considerable enhancement on cooling, enabling superconducting magnets to be constructed using Nb–Ti to produce fields in excess of 10 T when operated at approximately 2 K. The linear dependence of critical current density on temperature described by Hampshire, Sutton and Taylor is not continued below about 3 K. (auth)

Equipment and Devices

Refer also to abstracts 24399–24401, 25235, 25293, 25300, 25301, 25341, 25342, and 26768.

26053 RECEIVING-AMPLIFYING SYSTEM WITH A SUPERCONDUCTING BOLOMETER. Pankratov, N. A.; Zaitsev, G. A.; Khrebtov, I. A. Instrum. Exp. Tech. (USSR) (Engl. Transl.); 15: No. 6, 1866-1868(1972).

Translated from Prib. Tekh. Eksp.; 15: No. 6, 212-214(1972).

A receiving-amplifying system with a superconducting Sn bolometer is described for recording infrared in the spectral range >50 μ. The receiving area of the bolometer is 1×10 mm; the time constant is 7×10^{-3} sec. At a modulation frequency of 12.5 Hz the equivalent noise power is NEP = 3×10^{-12} W/Hz$^{1/2}$ for an aperture $\Omega = \pi/30$. The use of black gold allowed the noise to be reduced to NEP = 4×10^{-13} W/Hz$^{1/2}$ for $\Omega = \pi/600$. (auth)

26054 COMPARISON BETWEEN THE CONSTANT-POTENTIAL STEPS OF TWO POINT-CONTACT JOSEPHSON JUNCTIONS. Macfarlane, J. C. (CSIRO Division of Applied Physics, National Standards Laboratory, Sydney, Australia). Appl. Phys. Lett. 22: No. 10, 549-550 (15 May 1973).

Microwave-induced steps on the current-potential characteristics of two niobium point-contact junctions have been compared using a SQUID voltmeter with a resolution of less than 10^{-12} V. It has been established that the uncertainty in step potential at the 1-mV level is less than 2 in 10^9. (auth)

26055 PERMANENT MULTIPOLE MAGNETIC FIELDS STORED IN SUPERCONDUCTORS. Garwin, E. L.; Rabinowitz, M.; Frankel, D. J. (Stanford Linear Accelerator Center, Stanford University, Stanford, California, 94305). Appl. Phys. Lett. 22: No. 11, 599-600 (1 June 1973).

Hollow superconducting cylinders of Pb, Nb, and Nb_3Sn were used to permanently store dipole, quadrupole, and sextupole magnetic fields with high fidelity to the original fields. Fields were trapped transversely to the axes of solid, hollow, and split hollow cylinders. This experimental demonstration indicates that it should be possible to store any multipole magnetic field configuration by this method. Important benefits should accrue to technologies dealing with the focusing of charged particle beams, such as accelerators, electron microscopes, etc. Use of field trapping permits determination of the fluxoid pinning force. (auth)

26056 PROCEEDINGS OF THE FOURTH INTERNATIONAL CRYOGENIC ENGINEERING CONFERENCE, EINDHOVEN, NETHERLANDS, MAY 24–26, 1972. Guildford, Eng.; IPC Science and Technology Press Ltd. (1972). 382p. (Conf-720565–).

Ninety-three papers are included. Separate abstracts were prepared for fifty-two. The remaining papers are outside the subject scope of NSA. (MHR)

For abstracts of individual papers see: 24399–24401, 25300, 25301, 25341, 25342, 26024–26026, 26043–26052, and 26057–26088.

26057 TRENDS IN THE USE OF VERY LOW TEMPERATURE REFRIGERATION. Lacaze, A. (Centre de Recherches sur les Tres Basses Temperatures, Grenoble, France). pp 7-13 of Proceedings of the Fourth International Cryogenic Engineering Conference. Guildford, Eng.; IPC Science and Technology Press Ltd. (1972).

From 4th international cryogenic engineering conference; Eindhoven, Netherlands (24 May 1972). See Conf-720565–.

A review is given of the development of low-temperature refrigeration and some present applications together with predictions concerning future possibilities both for refrigerators and cryogenics. (auth)

26058 JAPANESE MAGNETICALLY SUSPENDED TRAIN PROJECT. Oshima, K. (Tokyo Univ.); Kyotani, Y. pp 26-34 of Proceedings of the Fourth International Cryogenic Engineering Conference. Guildford, Eng.; IPC Science and Technology Press Ltd. (1972).

From 4th international cryogenic engineering conference; Eindhoven, Netherlands (24 May 1972). See Conf-720565–.

A review is given of the work being carried out at Japan National Railways towards the development of a high speed ground transportation system making use of superconducting magnet levitation. (auth)

26059 GENERATION AND MEASUREMENT OF VERY LOW TEMPERATURES WITH DILUTION REFRIGERATORS. Peshkov, V. P. (Inst. for Physical Problems, Moscow). pp 41-46 of Proceedings of the Fourth International Cryogenic Engineering Conference. Guildford, Eng.; IPC Science and Technology Press Ltd. (1972).

From 4th international cryogenic engineering conference; Eindhoven, Netherlands (24 May 1972). See Conf-720565–.

The general principles of dilution refrigerators and heat balance in them are discussed together with the problem of heat exchange in different parts of the refrigerator, viscous heating in a continuous cycle and in a one-cycle refrigerator, the refrigeration capacity and limiting temperatures of refrigerators, gravitational instability in refrigerators, the problem of thermal equilibrium in the still and mixing chambers, the measurement of temperature in dilution refrigerators and temperature of the sample connected to the mixing chamber and the relaxation between measured and thermodynamic temperatures. (auth)

26060 USE OF AN EXPANSION EJECTOR IN A 5-W REFRIGERATOR AT 1.8K. Mulder, J. (Philips Research Labs., Eindhoven, Netherlands). pp 111-114 of Proceedings of the Fourth International Cryogenic Engineering Conference. Guildford, Eng.; IPC Science and Technology Press Ltd. (1972).

From 4th international cryogenic engineering conference; Eindhoven, Netherlands (24 May 1972). See Conf-720565–.

To a refrigerator using compressors, the usual heat exchangers and two pre-cooling stages (Philips double-stage cryogenerator), an expansion ejector is added to reach temperatures down to 1.8 K. A so-called water-ring compressor (with a drying installation) compresses the helium gas from 30 torr to 1 atm in a single stage. A double-stage Corblin compressor raises the pressure from 1 atm to about 20 atm. With the aid of the three heat exchangers and the pre-cooling stages the helium gas is cooled down to 2.1 K. In the primary loop of the ejector the high-pressure gas is expanded to 30 torr. In the secondary loop the pressure is further lowered to

12.5 torr in a throttling valve giving a temperature of 1.8 K with a cold production of 5 W. (auth)

26061 APPLICATIONS OF GAMMA-RAY THERMOMETRY AT LOW TEMPERATURES. Brewer, W. D.; Klein, E.; Rosenthal, B. H.; Steiner, P. (Freie Univ., Berlin). pp 115-118 of Proceedings of the Fourth International Cryogenic Engineering Conference. Guildford, Eng.; IPC Science and Technology Press Ltd. (1972).

From 4th international cryogenic engineering conference; Eindhoven, Netherlands (24 May 1972). See Conf-720565–.

Low temperature thermometry experiments were carried out using several "gamma-ray thermometers"—^{161}Dy/Dy metal and Eu^{151}/EuIG Moessbauer effect, and Co^{60}Co(hcp), Co^{60}Fe, and Ir^{191}Fe nuclear orientation—in conjunction with carbon resistance thermometers. The results illustrate the use of gamma-ray methods of low-temperature thermometry in the temperature range 20 mK ≤ T ≤ 400 mK. The resistor calibrations obtained were fitted to various empirical R–T functions. The boundary resistances between carbon resistors and copper contact sleeves or liquid helium were measured. The applicability of gamma-ray thermometry to low-temperature measurements is discussed. (auth)

26062 DILUTION REFRIGERATION CRYOSTAT FOR HIGH PRESSURE EXPERIMENTS. Stritzker, B.; Wittig, J.; Wuehl, H. (Kernforschungsanlage, Juelich, Ger.). pp 131-132 of Proceedings of the Fourth International Cryogenic Engineering Conference. Guildford, Eng.; IPC Science and Technology Press Ltd. (1972).

From 4th international cryogenic engineering conference; Eindhoven, Netherlands (24 May 1972). See Conf-720565–.

An ^{3}He/^{4}He dilution refrigeration cryostat, particularly designed for high pressure experiments, has been developed and successfully operated down to temperatures between 60 and 70 mK. A concentric tube counter flow heat exchanger is used. The cryostat is being used for the investigation of the pressure induced superconductivity among early transition and pretransition metals. A similar dilution refrigerator employs a cold valve to fill an extra tank, attached to the mixing chamber, with liquid He^4 or, alternatively, to evacuate the tank. This feature makes the cryostat a versatile instrument for the investigation of quenched condensed films at very low temperatures. In particular, very dilute alloys can thus be prepared by low-temperature ion implantation and studied down to temperatures of the order of 100 mK. (auth)

26063 NEW 13 255 FILAMENT SUPERCONDUCTING COMPOSITE. Popley, R. A. (Imperial Metal Industries, Kynoch Ltd., Birmingham, Eng.); Sambrook, D. J.; Walters, C. R.; Wilson, M. N. pp 165-167 of Proceedings of the Fourth International Cryogenic Engineering Conference. Guildford, Eng.; IPC Science and Technology Press Ltd. (1972).

From 4th international cryogenic engineering conference; Eindhoven, Netherlands (24 May 1972). See Conf-720565–.

A new type of superconducting composite which has been designed specifically for use in pulsed magnets is described. An essential feature of the new composite is that the niobium–titanium filaments are surrounded by a complex matrix having an anisotropic electrical resistivity. It is hoped that this new feature will enable composites to be made which contain many more filaments than previously and yet have a low hysteresis loss and are stable. (auth)

26064 ELECTRIC POWER TRANSMISSION BY CRYOCABLES. Schwab, M. A. M.; Deschamps, L. (Direction des Etudes et Recherches, Clamart, France). pp 168-171 of Proceedings of the Fourth International Cryogenic Engineering Conference. Guildford, Eng.; IPC Science and Technology Press Ltd. (1972).

From 4th international cryogenic engineering conference; Eindhoven, Netherlands (24 May 1972). See Conf-720565–.

Resistive cryocables which are cooled at liquid-nitrogen temperature (77 K) and superconducting cryocables cooled at liquid-helium temperature (4.2 K) seem to be well adapted to the transmission of very large amounts of energy. Their compactness, their thermal independence with the surrounding medium and the improved electrical conductivity permit higher currents and therefore, unit capacity can be increased. Conception of cryocables, knowledge of properties of their various components and cryogenic techniques have improved during the last few years. Economic study has been reviewed and the actual cost of this equipment could have been approached more accurately. Costs of transmission by ac resistive cryocables and by ac and dc superconducting cryocables are compared, and the advantage of these cryogenic techniques over the other new techniques is studied in relation to foreseeable future needs. (auth)

26065 SUPERCONDUCTING DEVICES FOR ENERGY STORAGE AND SWITCHING. Krebs, J. P.; Santamaria, E.; Maldy, J. (Centre de Recherches de la CGE, Marcoussis, France). pp 172-176 of Proceedings of the Fourth International Cryogenic Engineering Conference. Guildford, Eng.; IPC Science and Technology Press Ltd. (1972).

From 4th international cryogenic engineering conference; Eindhoven, Netherlands (24 May 1972). See Conf-720565–.

After a short recall of basic principles, a description is given of the different components of superconducting devices designed for a high energy storage (10^6 to 10^8 J) and fast discharge in order to provide high power pulses (10^6 to 10^9 MW). Operating conditions of these different components are analyzed. It is shown that a magnetic superconducting switch can be realized with high critical magnetic field superconductors. The triggering magnetic energy is kept at a low level by optimizing the switch shape and by properly adjusting the intensity and time-constant of the trigger signal. After giving theoretical results, experiments made at Marcoussis in this field are described: (1) Realization of thin layers of lead-bismuth alloys deposited on Mylar ribbon intended for building a superconducting switch able to stop the discharge when desired. (2) Design, realization, and testing of fully superconducting power pulse generators. Fields of interest for pulse generators that are able to deliver very fast discharges are pointed out. (auth)

26066 MULTIPLE USE OF CRYOGENIC FLUID TRANSMISSION LINES. Bartlit, J. R.; Edeskuty, F. J.; Hammel, E. F. (Los Alamos Scientific Lab., NM). pp 177-180 of Proceedings of the Fourth International Cryogenic Engineering Conference. Guildford, Eng.; IPC Science and Technology Press Ltd. (1972).

From 4th international cryogenic engineering conference; Eindhoven, Netherlands (24 May 1972). See Conf-720565–.

A multi-use energy transmission line is envisaged which derives environmental and economic advantages by concurrently transporting liquefied natural gas, liquid hydrogen, and electricity conducted along either cryogenic (20 K) or superconducting (4 K) cables. Operating parameters are given for a potential application of a 600-mile pipeline carrying gas and electricity flowing from New Mexico to Los Angeles, California, and liquid hydrogen flowing from Los Angeles to New Mexico for use in the space shuttle program. Estimated flow-rates, pipe sizes, pressure and voltage losses, heat leaks, and refrigeration requirements are given and compared with losses incurred in conventional transmission. (auth)

26067 LIQUID-NITROGEN-COOLED CRYORESISTIVE CABLES. Rechowicz, M; Weedy, B. M. (Univ. of Southampton, Eng.). pp 181-184 of Proceedings of the Fourth International Cryogenic Engineering Conference. Guildford, Eng.; IPC Science and Technology Press Ltd. (1972).

From 4th international cryogenic engineering conference; Eindhoven, Netherlands (24 May 1972). See Conf-720565–.

The dielectric strength and dielectric loss characteristics of lapped paper and plastic insulation has been undertaken with a view to application in cryoresistive or superconducting power cables. Breakdown strength has been studied as a function of hydrostatic pressure and relative humidity of the sample. Dc and impulse measurements have also been made. Measurements have also been taken on a 4-m length of a commercially stranded aluminum cable which is flexible. The cable had a large hollow bore and was insulated with conventional 275 kV insulation. The purpose of this exercise was to study: (1) Current capability both dc and ac at 77 K. (2) Eddy current losses. (3) Thermal contraction; movement of conductor inside insulation. (4) Thermal resistivity of the insulation and flow paths of liquid nitrogen through the thick insulation. (5) Both breakdown and dielectric loss of shorter samples of this cable. (auth)

26068 HIGH-SPEED GROUND TRANSPORTATION USING SUPERCONDUCTING MAGNETIC SUSPENSION. Borcherts, R. H.; Davis, L. C.; Reitz, J. R.; Wilkie, D. F. (Ford Motor Co., Detroit). pp 185-187 of Proceedings of the Fourth International Cryogenic Engineering Conference. Guildford, Eng.; IPC Science and Technology Press Ltd. (1972).

From 4th international cryogenic engineering conference; Eindhoven, Netherlands (24 May 1972). See Conf-720565–.

A mathematical model has been developed and checked experimentally to accurately predict the speed dependence of the lift and drag forces of the superconducting magnets above an aluminum sheet. Also power spectral density techniques have been used to predict the magnet control requirements for a given guideway roughness from ride quality point of view. Although the large clearance obtained between the superconducting magnet and the aluminum guideway reduces the requirements for a close tolerance guideway, propulsion by a conventional linear induction motor then becomes more difficult. While lack of magnetic suspension at low speeds will probably require wheels below 80 km/hr, the high magnetic L/D rations (50 to 60 at 400 km/hr) and the fact that this ratio increases with speed presents strong support for this method of suspension. (auth)

26069 CHARACTERISTICS OF MAGNETIC LEVITATION FOR HIGH SPEED TRAINS. Takano, I.; Saito, Y.; Ogiware, H. (Toshiba Research and Development Center, Kawasaki, Japan). pp 188-190 of Proceedings of the Fourth International Cryogenic Engineering Conference. Guildford, Eng.; IPC Science and Technology Press Ltd. (1972).

From 4th international cryogenic engineering conference; Eindhoven, Netherlands (24 May 1972). See Conf-720565–.

The magnetic levitation characteristics of a pair of vehicle coils with plus and minus magnetic poles are studied with respect to the alternate components of lift and drag forces. Calculations are based on the spatial variations of the mutual inductance between a single vehicle and ground loops of rectangular shape. (auth)

26070 EXPERIMENTAL STUDIES ON LARGE SUPERCONDUCTING MAGNETS FOR MAGNETICALLY SUSPENDED TRAINS. Takano, N.; Ogiwara, H.; Saito, Y.; Nakayama, Y.; Yonemitsu, H. (Toshiba Research and Development Center, Kawasaki, Japan). pp 191-193 of Proceedings of the Fourth International Cryogenic Engineering Conference. Guildford, Eng.; IPC Science and Technology Press Ltd. (1972).

From 4th international cryogenic engineering conference; Eindhoven, Netherlands (24 May 1972). See Conf-720565–.

Superconducting magnets for studying the characteristics of magnets for a model magnetically suspended train have been designed and constructed. The magnets were situated in an electromagnetic force field and the structural strength of the magnets and the lift forces on the soils determined. The dynamic suspended characteristics and the stability of superconductivity are also reported on. (auth)

26071 MAGNETIC LEVITATION AND POWER TRANSMISSION. Ogiwara, H.; Takano, N.; Saito, Y.; Nakayama, Y.; Yonemitsu, H. (Toshiba Research and Development Center, Kawasaki, Japan). pp 194-197 of Proceedings of the Fourth International Cryogenic Engineering Conference. Guildford, Eng.; IPC Science and Technology Press Ltd. (1972).

From 4th international cryogenic engineering conference; Eindhoven, Netherlands (24 May 1972). See Conf-720565–.

The design and size of model superconducting magnets for use in studying problems concerning the design, construction and levitation characteristics of a 500 km/hr magnetically suspended train are considered. (auth)

26072 PRELIMINARY TECHNICAL ASSESSMENT OF MAGNETICALLY SUSPENDED TRAINS. Alston, I, A.; Hayden, J. T. (Cranfield Inst. of Tech., Eng.). pp 198-201 of Proceedings of the Fourth International Cryogenic Engineering Conference. Guildford, Eng.; IPC Science and Technology Press Ltd. (1972).

From 4th international cryogenic engineering conference; Eindhoven, Netherlands (24 May 1972). See Conf-720565–.

Repulsive magnetic suspensions for tracked vehicles are discussed. Vehicles suspended in this way are essentially for high-speed ground transport. Technical specifications for such vehicles are drawn up in order to make a comparison with other high-speed ground transport systems. (auth)

26073 CONTRIBUTION TO MAGNETIC LEVITATION TECHNOLOGY. Bohn, G.; Romstedt, P.; Rothmayer, W.; Schwaerzler, P. (Krauss-Maffei AG, Munich). pp 202-208 of Proceedings of the Fourth International Cryogenic Engineering Conference. Guildford, Eng.; IPC Science and Technology Press Ltd. (1972).

From 4th international cryogenic engineering conference; Eindhoven, Netherlands (24 May 1972). See Conf-720565–.

Some investigations concerning optimum magnet design, eddy current effects and electronic control systems for an electromagnetic levitation system are discussed. (auth)

26074 THREE Nb–Ti SUPERCONDUCTING MAGNETS DIFFERING IN CONCEPTION AND OPERATING TEMPERATURE. Berthet, M. (Centre de Recherches de la CGE, Marcoussis, France). pp 209-213 of Proceedings of the Fourth International Cryogenic Engineering Conference. Guildford, Eng.; IPC Science and Technology Press Ltd. (1972).

From 4th international cryogenic engineering conference; Eindhoven, Netherlands (24 May 1972). See Conf-720565–.

Superconducting magnets now operated are cooled by putting the coil in liquid helium at 4.2 K. Cooling channels allow direct contact between liquid helium and well-stabilized conductor. A helium refrigerator may be used to cool the magnet in a closed loop. The coil may have to bear high voltage. Then insulation prevents conductor cooling and the design of coil has to be different. Two solutions are considered: (1) the coil is cooled by hypercritical helium circulation inside a hollow conductor; (2) multifilamentary intrinsically stable conductors are used. Test results are given for coils realized in the following ways: (1) Design, realization and testing of a magnet delivering 3 T in an 80 cm diameter cylinder at room temperature (energy stored, 5.5 MJ). The coil is wound with a 1700 A aluminium-stabilized Nb–Ti conductor and placed in a toroidal cryostat where it is cooled by an helium refrigerator in a closed loop. (2) Realization and testing of a coil model cooled by hypercritical helium circulation, operated by an independent circulator or by the cycle compressor of helium refrigerator. The conductor is of hollow type. (3) Realization and testing of a coil wound with multifilamentary conductor of Nb–Ti thin filaments. (auth)

26075 30 kOe SUPERCONDUCTING COIL WITH REDUCED EXTERNAL FIELD. Krueger, P.; Martinelli, A. P. (Max-Planck Institut fuer Plasmaphysik, Garching, Ger.). pp 214-217 of Proceedings of the Fourth International Cryogenic Engineering Conference, Guildford, Eng.; IPC Science and Technology Press Ltd. (1972).

From 4th international cryogenic engineering conference; Eindhoven, Netherlands (24 May 1972). See Conf-720565–.

A superconducting magnet is described for an electron spin polarization experiment. The magnet has to meet stringent requirements: maximum field 30 kOe, 2% per cm axial homogeneity, and B_z (external axial field) smaller than 1 Oe at 30 cm from the centre of the magnet. Since the available dimensions for the coil are limited (3 cm ID, 12 cm OD, 6 cm length), the high current density necessary can only be obtained by using superconductors. A normally wound coil having the above dimensions has an axial field of about 35 Oe at 30 cm from the coil centre. This field cannot be reduced to below 1 Oe using an iron shield, owing to lack of space. A compensated coil is therefore calculated and constructed. It consists of three coaxial windings, of which the innermost homogenizes the field, while the middle and outermost ones, which are energized in opposition, produce and compensate the axial external field of 30 kOe. Since the set-up of which the coil is part has to be operated in ultra-high vacuum, it has to be heated beyond 200°C. The superconducting joints in the winding may not be soldered and will have to be welded or cold joined. Furthermore, to detect any degradation of the superconductor performance, tempering tests at 200°C and above are carried out on the superconducting wire, which is supplied with insulation capable of withstanding 240°C for 20,000 hours. (auth)

26076 MAGNETOMETERS USING SUPERCONDUCTING GALVANOMETERS. Gelsing, R. R.; van Kempen, H. (Katholicke Univ., Nijmegan, Netherlands). pp 233-235 of Proceedings of the Fourth International Cryogenic Engineering Conference. Guildford, Eng.; IPC Science and Technology Press Ltd. (1972).

From 4th international cryogenic engineering conference; Eindhoven, Netherlands (24 May 1972). See CONF-720565–.

Four different magnetometers are described and compared. One is a vibrating sample type and the other three use a superconducting galvanometer. It is shown that the latter type can have a high sensitivity without any of the drawbacks of the vibrating sample type. The vibrating coil galvanometer gives the highest sensitivity while the field probe galvanometer is easiest to construct. (auth)

26077 SUPERCONDUCTING AC MACHINES: AN APPROACH TO DEVELOPMENT. Warne, D. F.; Hadlow, M. E. (Electrical Research Association, Surrey, Eng.). pp 239-242 of Proceedings of the Fourth International Cryogenic Engineering Conference. Guildford, Eng.; IPC Science and Technology Press Ltd. (1972).

From 4th international cryogenic engineering conference; Eindhoven, Netherlands (24 May 1972). See CONF-720565–.

The ERA has recently assessed the future of superconductivity in ac rotating machines and examined particularly the minimum rating offering savings over conventional machines and the possibilities of geometrical innovation. The results of this study, which is not a detailed design study, are discussed. (auth)

26078 CRYOGENIC ASPECTS OF ROTATING SUPERCONDUCTING FIELD COILS FOR SUPERCONDUCTING MACHINES. Stekly, Z. J. J.; Robinson, G. Y. Jr. (Electrical Research Association, Surrey, Eng.). pp 243-246 of Proceedings of the Fourth International Cryogenic Engineering Conference. Guildford, Eng.; IPC Science and Technology Press Ltd. (1972).

From 4th international cryogenic engineering conference; Eindhoven, Netherlands (24 May 1972). See CONF-720565–.

The use of rotating superconducting field windings in synchronous machines is a result of trading off the problems of slip rings which are necessary to remove the power from a rotating armature for the problems of maintaining a rotating superconducting winding at liquid–helium temperatures. Here the cryogenic aspects of the rotating superconducting field winding are discussed. Specifically, the sources of heat leak are examined to determine their order of magnitude; next, the peculiar problems of the supply and use of liquid helium in a rotating Dewar are discussed. (auth)

26079 DEVELOPMENTS WITH SUPERCONDUCTING AC GENERATORS. Appleton, A. D.; Anderson, A. F. (International Research and Development Co. Ltd., Newcastle-upon Tyne, Eng.). pp 247-252 of Proceedings of the Fourth International Cryogenic Engineering Conference. Guildford, Eng.; IPC Science and Technology Press Ltd. (1972).

From 4th international cryogenic engineering conference; Eindhoven, Netherlands (24 May 1972). See CONF-720565–.

The development of superconducting generators undertaken by IRD on behalf of C. A. Parsons and Company Limited is reviewed. An outline design of a machine concept is presented with a discussion of the more critical development problems. (auth)

26080 SUPERCONDUCTING GENERATORS FOR AIRCRAFT. Hayden, J. T. (Cranfield Inst. of Tech., Eng.). pp 253-255 of Proceedings of the Fourth International Cryogenic Engineering Conference. Guildford, Eng.; IPC Science and Technology Press Ltd. (1972).

From 4th international cryogenic engineering conference; Eindhoven, Netherlands (24 May 1972). See CONF-720565–.

Estimates of the specific weights, performance characteristics and general features are given of 400 Hz alternators suitable for use in aircraft and incorporating superconducting field windings. (auth)

26081 DEVELOPMENTS WITH SUPERCONDUCTING DC MACHINES. Appleton, A. D. (International Research and Development Co. Ltd., Newcastle-upon-Tyne, Eng.). pp 256-262 of Proceedings of the Fourth International Cryogenic Engineering Conference. Guildford, Eng.; IPC Science and Technology Press Ltd. (1972).

From 4th international cryogenic engineering conference; Eindhoven, Netherlands (24 May 1972). See CONF-720565–.

The development of superconducting machines at International Research and Development Company Limited, since 1963 is described. The work has been carried out on behalf of the Ministry of Defence (Navy), the National Research Development Corporation and C. A. Parsons and Company Limited. In 1966 a 50 hp model superconducting homopolar motor was commissioned, and in 1971 full load tests were performed on a 3250 hp motor (the Fawley motor). At the present time IRD is engaged upon the construction of two superconducting dc machines, one motor and one generator, for a marine propulsion system which will undergo sea trials in 1973. (auth)

26082 MEASUREMENT OF THERMAL RESISTANCE BETWEEN MATERIALS POTTED IN EPOXY RESINS. Brauns, P. (CEN, Grenoble, France); Doulat, J.; Genevey, P. pp 270-273 of Proceedings of the Fourth International Cryogenic Engineering Conference. Guildford, Eng.; IPC Science and Technology Press Ltd. (1972).

From 4th international cryogenic engineering conference; Eindhoven, Netherlands (24 May 1972). See CONF-720565–.

A superconducting magnet energized by a pulsed current has magnetization losses. Mechanical considerations and current density in the dipole being constructed at SACLAY led to the winding being potted in epoxy resin. The pulsed current losses are evacuated toward the helium bath by insulated copper heat drains. The knowledge of over-all thermal resistance between heat drains and superconducting material is thus essential and is carried out on a sample made of two layers stuck on each other by epoxy resin. The material of these layers is a mat of insulated wires or superconducting wires. The sample is placed in a vacuum calorimeter. Two types of calorimeters have been used: in the first the measurement is made at a temperature close to the dipole working temperature (about 4.5 to 4.6 K) and the temperature difference measured by two Allen Bradley carbon resistors and in the second, measurements at variable temperatures are possible, the temperature difference being measured by a thermocouple and the microvoltage amplified with a low background noise amplifier. Tests have been made with different filled epoxy resins and different mats of copper wires (the superconductor being a IMI 1044 wire). (auth)

26083 MEASUREMENTS OF FORCED CONVECTION HEAT TRANSFER TO SUPERCRITICAL HELIUM. Ogata, H.; Sato, S. (Central Research Lab., Hitachi Ltd., Tokyo). pp 291-294 of Proceedings of the Fourth International Cryogenic Engineering Conference. Guildford, Eng.; IPC Science and Technology Press Ltd. (1972).

From 4th international cryogenic engineering conference; Eindhoven, Netherlands (24 May 1972). See CONF-720565–.

Heat transfer to forced supercritical helium was measured at fluid temperatures of 4.2 to 11 K and pressures of 2 to 15 atm (0.2 to 1.5 MN/m^2). The test section was a 0.109 cm inner diameter ×8.50 cm long stainless steel tube through which helium flowed vertically upwards. Measured results have shown that supercritical helium is similar to ordinary supercritical fluids in turbulent heat transfer. For example, an enhancement of the heat transfer coefficient occurs near the transposed critical temperature and the enhancement disappears at high heat flux. The data were compared with the correlation proposed by Mirolpolskii et al. Som phenomena like "pseudo-boiling" were observed. (auth)

26084 PHYSICAL PROPERTIES OF ELECTRICAL INSULATING MATERIALS AT CRYOTEMPERATURES. Javorskii, E. (Cables and Insulating Materials Research Inst., Bratislava, Czech.). pp 341-343 of Proceedings of the Fourth International Cryogenic Engineering Conference. Guildford, Eng.; IPC Science and Technology Press Ltd. (1972).

From 4th international cryogenic engineering conference; Eindhoven, Netherlands (24 May 1972). See CONF-720565–.

The practical application of cryotechniques in the generation and transfer of electrical energy depends to a great extent on the physical properties of electrically insulating materials. Up to now there has been a lack of knowledge about the long-term application of these materials. The aging of insulating materials in cryogenic conditions in electrical fields and its dependence on physical properties is a topic that requires considerable attention. A brief review of the work on this subject carried out by the Bratislava Research Institute is presented here. (auth)

26085 SUPERCONDUCTING CABLES MADE FROM METALS IN POROUS GLASS. Watson, J. H. P. (Corning Glass Works, NY). pp 344-346 of Proceedings of the Fourth International Cryogenic Engineering Conference. Guildford, Eng.; IPC Science and Technology Press Ltd. (1972).

From 4th international cryogenic engineering conference; Eindhoven, Netherlands (24 May 1972). See CONF-720565–.

The problems are outlined of incorporating composites, consisting of Pb–40%Bi in porous glass, into a practical cable. (auth)

26086 FABRICATION STUDIES OF Nb_3Al AND Nb_3AlGe SUPERCONDUCTORS. Worzala, F. J. (Univ. of Wisconsin, Madison); Yang, W. J.; Strauss, B. P.; Boom, R. W.; Laurence, J. pp 347-350 of Proceedings of the Fourth International Cryogenic Engineering Conference. Guildford, Eng.; IPC Science and Technology Press Ltd. (1972).

From 4th international cryogenic engineering conference; Eindhoven, Netherlands (24 May 1972). See CONF-720565–.

One of the difficulties encountered in fabricating conductors of Nb_3Al is the high temperature (1650°C) required to form a continuous layer of Nb_3Al. Matthias and Kohr have described fabrication methods. Two other fabrication methods are reported here. In the first, Nb and Al are co-extruded and then reacted in a zone-melting induction heater to form a thin layer of intermetallic compound at the interface. Significant diffusion takes place at temperatures lower than 1100°C. In the second process, Nb rods were placed in an Al–Ge bronze billet, which was then reacted at 1000°C after mechanical reduction of the composite. The composite was reacted by means of the zone melting process. This resulted in the rapid diffusion of aluminum and germanium from the copper and the formation of the intermetallic compound. Metallographic analysis and cryogenic properties of the composite conductors are presented. The advantages and disadvantages of both processes are discussed, along with their applicability for producing commercial grade superconductors. (auth)

26087 REMOTELY OPERATED ELECTROMECHANICAL CRYOGENIC SWITCH, 100 A, 1μΩ TO INFINITE RESISTANCE. Krueger, P. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). pp 354-357 of Proceedings of the Fourth International Cryogenic Engineering Conference. Guildford, Eng.; IPC Science and Technology Press Ltd. (1972).

From 4th international cryogenic engineering conference; Eindhoven, Netherlands (24 May 1972). See CONF-720565–.

A cryogenic switch is described which has a resistance in the micro-ohm range in the "on" position and a practically infinite resistance in the "off" position. The whole volume of the switch is about 100 cc. The contact surfaces are made from superconducting Nb_3Sn tape. The necessary pressure (a few kg) between the contact surfaces is achieved with a mechanical flip-flop (two-position) spring system which is triggered in the "on-off" position by an electrical pulse. The electrical pulse is supplied to the cryogenic switching system by discharging a capacitor at room temperature alternately into two coils which act on the "on-off" switching mechanism by the eddy current effect. Optimization of the switch, particularly as to the external energy required to operate it, as well as performance results are reported. The switch, originally developed for use in the superconducting quad-

rupole W6 at IPP, is suitable for general cryogenic applications. (auth)

26088 SUPERCONDUCTING MAGNET AND HIGH-PRESSURE MULTIPLICATOR COMBINED SYSTEM. Kirschner, I.; Kovacs, I.; Laszloffy, L. (Roland Eoetvoes Univ., Budapest). pp 372-374 of Proceedings of the Fourth International Cryogenic Engineering Conference. Guildford, Eng.; IPC Science and Technology Press Ltd. (1972).

From 4th international cryogenic engineering conference; Eindhoven, Netherlands (24 May 1972). See CONF-720565–.

The construction of a laboratory measuring apparatus with superconducting magnet and beryllium-bronze bomb for magnetic and high-pressure investigations is described. (auth)

PHYSICS (NUCLEAR)

Neutron Interactions with Matter

Refer also to abstracts 24983, 24985, 25206, 25318, 25321, 25331, 26182, 26512, and 26619.

26089 (ANL-7416(Suppl.)) ARGONNE CODE CENTER: Benchmark Problem Book. Numerical Determination of the Space, Time, Angle, or Energy Distribution of Particles in an Assembly. (Argonne National Lab., ILL). Dec 1972. Contract W-31-109-Eng-38. 123p. Dep. NTIS $5.45.

This report is a supplement to ANL-7416, which was abstracted as NSA 22: 46693. The Benchmark Problem Book is intended to serve as a source-book of solutions to mathematically well-defined problems for which either analytical or very accurate approximate solutions are known. This supplement contains three additional source situations: two-dimensional isolated source in an absorbing medium, infinite slab reactor model, and monoenergetic point reactor model. It should be noted that the supplement contains only the additional pages and those requiring modification; the remaining pages appearing in the original report are not included. (RWR)

26090 (EUR-4954, pp 29-32) NEUTRON MAGNETIC SCATTERING FROM MAGNETICALLY INACTIVE SUBSTANCES. Yamada, Y. (Osaka Univ.). Apr 1973.

From joint meeting on pulsed neutrons and their utilization; Ispra, Italy (17 Sep 1971).

The neutron scattering cross section from an isolated two electron system which forms the chemical bonding of a diatomic molecule is calculated. (EU)

26091 (EUR-4954, pp 287-291) INVESTIGATIONS ON MODERATORS FOR A PULSED COLD NEUTRON SOURCE. Sumita, K. (Osaka Univ.). Apr 1973.

From joint meeting on pulsed neutrons and their utilization; Ispra, Italy (17 Sep 1971).

Many theoretical and experimental works have been carried out to investigate the characteristics of the moderator at the very low temperature under liquid nitrogen temperature for the design of a cold neutron source. Neutron spectrum measurements in light water, heavy water, and methane are given. From the point of view of neutron behavior, para hydrogen, which gave the shortest broadening pulsed width and the lowest pseudo neutron temperature, could serve. (EU)

26092 (INDC(SEC)-31-U, pp 25-36) REMARKS ON THE U-238 INELASTIC SCATTERING CROSS-SECTIONS. Benzi, V.; Menapace, E. (CNEN, Bologna). Jan 1973.

In topical discussion on inelastic scattering of fast neutrons.

The direct collective and single-particle contributions to the neutron inelastic scattering by ^{238}U are estimated by using the generalized optical model and the Brown–Muirhead model. The possible influence of these effects on the neutron energy spectrum in bulk uranium is discussed. (5 figures) (auth)

26093 (KFK-1784) MIGROS-2: A PROGRAM WRITTEN IN FORTRAN FOR THE CALCULATION OF MICROSCOPIC GROUP CONSTANTS FROM NUCLEAR DATA. Huschke, H.; Krieg, B. (comps.) (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Neutronenphysik und Reaktortechnik). Jun 1973. 204p. Dep. NTIS (U. S. Sales Only) $12.25.

MIGROS-2 allows the production of microscopic group constants of the ABN type. The Karlsruhe nuclear data file, KEDAK, is used as the nuclear data basis. All group constants necessary for diffusion, consistent P1, and S_n calculations, taking the anisotropy into account up to P_5, can be calculated. A description of the code and the underlying theory is given. Input and output descriptions, a sample problem, and the program listing are provided. (auth)

26094 (KFK-1812) SURVEY OF THE NUCLEAR DATA NEEDS IN ACTIVATION ANALYSIS. Muenzel, H.; Michaelis, W. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Radiochemie). Jun 1973. 26p. (INDC(GER)-12-UW). Dep. NTIS (U.S. Sales Only) $3.50.

The goals of the inquiry, the results of which are described in this report, were the following: a) to give a survey of the kind and the accuracy of nuclear data needed in activation analysis, and b) to provide information about the usefulness of the available compilations and to verify whether they cover the needs of the users. In the appendix a reference list for 87 compilations is given. (4 tables) (auth)

26095 (KFK-1815) STRUCTURE AND MANAGEMENT OF THE GRUBA FILE. Woll, D. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Neutronenphysik und Reaktortechnik). May 1973. 34p. (In German). Dep. NTIS (U. S. Sales Only) $3.75.

The GRUBA file contains nuclear data of different types, e.g., group-averaged cross sections, transfer elements and resonance self-shielding factors. The number of energy groups can be chosen arbitrarily. The structure of the data is flexible and allows the storage of various kinds of data for the same data type. In order to avoid multiple storing of identical data, the pointer technique is applied. The GRUBA file is used to calculate macroscopic group constants by the program GRUCAL. The program system GRUMA allows the establishment of a GRUBA file, change of data on a GRUBA file or extension of an existing GRUBA file. GRUSEEK is a general subroutine which can be called by other programs to read specified nuclear data of the GRUBA file. (1 figure, 2 tables) (auth)

26096 ANISOTROPIC EFFECTS IN NEUTRON SLOWING DOWN TIME EXPERIMENTS. Beynon, T. D.; Coleman, M. (Univ. of Birmingham, Eng.). Nucl. Instrum. Methods; 111: No. 2, 253-258(1973).

Transport theory calculations are made to examine the relative importance of neutron source anisotropy and neutron scattering anisotropy for neutron slowing-down times in light water, graphite, and lead. Isotropic, linearly anisotropic, and unidirectional sources are considered; and scattering is considered up to the second-order Legendre polynomial in the scattering angle. For slowing-down to epithermal energies in water the anisotropic effects contribute only 1 to 2% to the slowing down times, but the spatial dependence of the slowing-down time is seen to be sensitive to the angular anisotropy of the pulsed neutron source. For graphite, slowing-down times for energy changes from 10 MeV to the range 0.5 to 14 eV are insensitive to within 1 to 2% to the anisotropy of the source and scattering. For lead, in the final energy range 1 eV to 50 keV the anisotropic effects can contribute up to 5 percent to the slowing-down times. (5 figures) (auth)

26097 INELASTIC SCATTERING OF SLOW NEUTRONS ON SOLIDS. Glaeser, W.; Gompf, F.; Reichardt, W. (Kernforschungszentrum, Karlsruhe, Ger.). KFK Nachr.; 5: No. 2, 19-26(1973). (In German).

This review article gives a brief outline of the fundamentals of inelastic neutron scattering as compared to other methods of investigating atom movement in solids. Following this, both methods used in the FR2 (crystal spectrometry and time-of-flight method) are explained. As an example of the experiments carried out, the results of three important classes of solids (high-temperature superconductors, one-dimensional metals, molecule crystals) are discussed. (1 figure) (GE)

26098 INTERFERENCE IN NEUTRON SCATTERING IN ANHARMONIC CRYSTALS. Plakida, N. M. (Joint Institute for Nuclear Research, Dubna). Sov. Phys.–Solid State 14: No. 10, 2462-2467 (Apr 1973).

A recently developed theory of self-consistent phonons is used to study the scattering of neutrons by strongly anharmonic crystals. The one-phonon coherent cross section is calculated with an allowance for the interference with the many-phonon scattering cross sections corresponding to all orders of the scattering. It is found that, for strongly anharmonic crystals, the interference terms give rise to strong dependences of the position and of the profile of the one-phonon peak on the momentum transfer Q for $Ql/2\pi \gtrsim 2$. (auth)

26099 FIRST-FLIGHT COLLISION PROBABILITIES FOR NON-UNIFORM CARTESIAN SYSTEMS. Spiess, J. R. Pittsburgh; Carnegie-Mellon Univ. (1973). 196p. University Microfilms Order No. 73-18,327.

Thesis (Ph. D.).

A method was developed for computing first-flight collision probabilities in nonsymmetric, axially uniform Cartesian systems. The method provides a technique for computing the probabilities needed in spatially dependent multigroup flux calculations for collapsed cross sections or the depletion analysis of reactor assemblies. The computed probabilities represent collisionless neutron flight from each subregion and each boundary zone to all subregions and boundary zones of the system. Integral expressions for the probabilities are derived for an axially uniform system with any cross sectional geometry. A spatially constant and isotropic neutron emission from each subregion and an isotropic inward flux across each boundary zone of the

system are assumed. A FORTRAN IV computer program that was written to carry out the computation of the probabilities in Cartesian systems is described. A Monte Carlo program which estimates the mono-energetic neutron absorption fractions in two-dimensional Cartesian systems is used as a standard. The collision probability and Monte Carlo programs are applied to several monoenergetic systems with perfectly reflecting boundaries. These systems have geometries that are typical of BWR assemblies, and use typical fast and thermal group cross sections. The applications are used to investigate the accuracy of the collision probability method with respect to the number of discrete intervals used in the numerical integration, the size of the system subregions, and the maximum optical distance considered in the collisionless flight of a neutron. (RWR)

26100 EVALUATION OF THE ACTIVATION OF A THICK SAMPLE IN A MULTIPLYING ENVIRONMENT BY THE CONJUGATE WALK METHOD. Polevoi, V. B. At. Energ. (USSR); 34: No. 4, 296-298(Apr 1973). (In Russian).

A formal representation of the conjugate equation for migration, with which a migration pattern may be evaluated by the Monte-Carlo method, was applied to the solution of a practical problem: the evaluation of the activation of a sample situated in a multiplying medium. An algorithm was developed for the electronic computer M-220 for calculating the activation of a sodium indicator 0.68 cm thick located in a homogeneous mixture of ^{238}U, ^{239}Pu, O, and C. (KSW).

Nuclear Properties and Reactions, A ≤ 5

Refer also to abstracts 25874, 26008, 26224, and 26260.

26101 STATES IN THE A = 5 SYSTEM ABOVE THE THREE-PARTICLE THRESHOLD. Schroeder, H. (Univ., Freiberg i. B.); Kern, K.; Schmid, K.; Schmitt, L.; Schneider, F.; Fick, D.; Hofmann, H. M. (1973). vp. (In German).

From spring meeting of the Deutsche Physikalische Gesellschaft, Part A: nuclear physics; Heidelberg, Germany (19 Feb 1973).

With a 20 nA $^3He^{++}$ beam of the 7 MV Van de Graaff in Freiburg and with a 200 $\mu g/cm^2$ perdeuteroethylene foil on C backing the reaction D + $^3He \rightarrow p + t + p$ was studied. A $3/2^-$ state with the structure $^4He^*(O^+)p_{3/2}$ at $Ex^5Li = 18.9$ MeV was detected. Analogous to the ground state in $^5He/^5Li$, this state in ^5Li appears to be twice as high above the p + $^4He^*(O^+)$ threshold as in ^5He. There is some reason to assume a corresponding $3/2^+$ state with the structure $^4He^*(O^-)p_{3/2}$ at $Ex^5Li = 20$ MeV. (10 figures) (GE)

26102 DETERMINATION OF THE NEUTRON–NEUTRON SCATTERING LENGTHS BY THE BREAKUP REACTION OF THE DEUTERON D(n,p)2n. Dropmann, E. Aachen; Technische Hochschule (1971). 77p. (In German).

Thesis.

In a kinematically complete experiment for the study of the breakup reaction D(n,p)2n of the deuteron, the neutron–neutron scattering length a_{nn} has been determined in the exit channel via a final-state interaction of the neutrons. The most probable value is $a_{nn} = (-16.8^{+2.3}_{-2.3})$ fm. The uncertainties of the theoretical three-body model are not taken into account in the error analysis. Subject to these uncertainties, it can be said that the result is in accordance with the charge symmetry of nuclear forces. (GE)

26103 NORMALIZATION OF THE N–D TAIL OF THE TRINUCLEON WAVE FUNCTION. Lim, T. K. (Department of Physics and Atmospheric Science, Drexel University, Philadelphia, Pennsylvania, 19104). Phys. Rev. Lett. 30: No. 15, 709-710 (9 Apr 1973).

The normalization constant C of the N–d tail of the trinucleon wave function is derived from various sources. The measure of consistency between the extracted values, with $C^2(^3He) = 3.0$ and $C^2(^3H) = 3.4$, is strong support for according C the same status as other trinucleon parameters such as the binding energy, charge radius, and form factor. (auth)

26104 NUCLEON–DEUTERON SCATTERING. Rihan, T. H. (Faculty of Education, University of Libya, Tripoli, Libya); Sharaf, M. A. Phys. Rev. C 7: No. 6, 2204-2208 (June 1973).

The nucleon–deuteron scattering amplitude is investigated on the basis of a Feynman–diagram technique. A superposition of an exchange pole and triangle graphs is considered. With the aid of some reasonable approximations, the triangle amplitude is given in terms of a nucleon–nucleon amplitude. Angular distributions up to 155-MeV proton energy are calculated for p–d scattering using a phase-shift analysis for the nucleon–nucleon amplitude. Good agreement with the experimental results is obtained. (auth)

26105 ERRORS ON CHARGE DENSITIES DETERMINED FROM ELECTRON SCATTERING. Borysowicz, J.; Hetherington, J. H. (Physics Department and Cyclotron Laboratory, Michigan State University, East Lansing, Michigan 48823). Phys. Rev. C 7: No. 6, 2293-2303 (June 1973).

Errors on the charge distribution as derived from electron scattering are determined and they depend largely on assumptions about the possible large–q behavior of the form factor (i.e., at larger–q values than have been measured). We use rather general expansions for ρ (r), for example the cosine series or a set of spline functions. We find the charge distribution and its error to be not very dependent on the set of functions used for expansion but dependent instead on assumptions about and knowledge of the errors in f(q). Charge densities and their errors for ^3He and ^4He based on electron scattering are shown. (auth)

26106 PROTON–ALPHA–PARTICLE INELASTIC CHANNELS AT MEDIUM INCIDENT ENERGIES. Jung, M.; Sakamoto, Y.; Suren, J. N.; Jacquot, C.; Girardin, L. (Centre de Recherches Nucléaires, Universite Louis Pasteur, Laboratoire de Physique Corpusculaire, Strasbourg–Cronenbourg, France); (and others). Phys. Rev. C 7: No. 6, 2209-2218 (June 1973).

We measured the cross sections of the different inelastic channels for α+p reactions between 135 and 155 MeV. Starting with some simple assumptions, a theoretical description of differential and absolute cross sections has been sought to be applied to some cosmic–ray studies. (auth)

Nuclear Properties and Reactions, 6 ≤ A ≤ 19

Refer also to abstracts 24577, 25985, 26188, 26224, 26245, 26248, and 26256.

26107 (NP–19809) EFFECT OF CORE-EXCITATIONS AND Su_4 SYMMETRY BREAKING UPON THE MUON CAPTURE RATE IN ^{16}O. Saarela, M.; Erkkila, P.; Kallio, A. (Oulu Univ. (Finland). Dept. of Theoretical Physics). 1972. 33p. Dep. NTIS (U.S. Sales Only) $3.75.

The total muon capture rate in ^{16}O is calculated with improved ground-state wave function containing a deformed component. The results are given in the closure approximation and with the method of explicit summation over intermediate states. In the second case a rate only 30% greater than the experimental value is obtained. In all cases the SU_4-symmetry breaking is found to be less than 6%. (auth)

26108 (ORNL–TM-4311) PREDICTED PROTON SPECTRUM AT FORWARD ANGLES FOR 29.4-GeV N ON C COLLISIONS. Bertini, H. W.; Gabriel, T. A.; Santoro, R. T. (Oak Ridge National Lab., Tenn.). Sep 1973. Contract W-7405-eng-26. 11p. Dep. NTIS $3.00.

The proton spectrum over the angular interval from 0–10 mrad from the interactions of 29.4-GeV N on C has been calculated. The differential cross section for the emission of protons indicates that there is a significant number of emitted protons with energies greater than the energy per nucleon of the incident projectile (2.1 GeV). A brief description of the calculational method is included. (auth)

26109 (RLO-1388-221, pp 32-34) ISOSPIN MIXING IN ^{16}O IN THE VICINITY OF THE LOWEST T = 2 STATE. Adelberger, E. G.; Bussoletti, J. E.; Calarco, J. R.; Dietrich, F. S.; Nero, A. V. Jun 1973.

In annual report, 1973.

26110 (RLO-1388-221, pp 35-39) MICROSCOPIC ANALYSIS OF THE $^6Li(^6Li,^6Li^*(3.56))^6Li^*(3.56)$ AND THE $^6Li(^6Li,^6He)^6Be$ REACTIONS. Blair, J. S.; Cramer, J. G.; Wharton, W. R. Jun 1973.

In annual report, 1973

26111 (RLO-1388-221, pp 42-44) PRODUCTION OF ^6Li AND ^{10}B IN THE PROTON BOMBARDMENT OF ^{13}C. Bodansky, D.; Chamberlin, D.; Jacobs, W. W.; Oberg, D. L. Jun 1973.

In annual report, 1973.

26112 (RLO-1388-221, pp 45-47) ELECTROMAGNETIC DE-EXCITATION OF EXCITED STATES IN ^{12}C. Bodansky, D.; Chamberlin, D. D.; Jacobs, W. W.; Oberg, D. L. Jun 1973.

In annual report, 1973.

26113 (RLO-1388-221, pp 47-51) ACCELERATOR PRODUCTION OF ^8B NEUTRINOS. Adelberger, E. G.; Bodansky, D.; Marrs, R. E. Jun 1973.

In annual report, 1973.

26114 (RLO-1388-221, pp 81-85) $^{12}C(^{12}C,^{8}Be)^{16}O$ REACTION IN THE VICINITY OF THE QUASIMOLECULAR RESONANCES. Cooper, M. D.; Lau, P. H.; Reisdorf, W. N. Jun 1973.
In annual report, 1973.

26115 (RLO-1388-221, pp 88-90) EVIDENCE FOR TWO-NEUTRON EXCHANGE IN THE ELASTIC AND INELASTIC SCATTERING OF ^{18}O BY ^{16}O. Lau, P. H.; Reisdorf, W. N.; Vandenbosch, R. Jun 1973.
In annual report, 1973.

26116 (RLO-1388-221, pp 98-100) 15.11 MeV(1^+,T = 1) → 4.43 MeV(2^+,T = 0) GAMMA-BRANCH IN ^{12}C. Hasinoff, M. D.; Lim, B.; Snover, K. A. Jun 1973.
In annual report, 1973.

26117 (RLO-1388-221, pp 100-101) INELASTIC PROTON SCATTERING TO THE 12.7 AND 15.11 MeV LEVELS IN ^{12}C. Ebisawa, K.; Hasinoff, M.; Lim, S. T.; Measday, D. F.; Mulligan, T. J.; Spuller, J. E. Jun 1973.
In annual report, 1973.

26118 (RLO-1388-221, pp 102-103) CAPTURE MEASUREMENTS OF PROTONS ON ^{12}C: THE ENERGY REGION 16 MeV ≤ E_p ≤ 19 MeV. Ebisawa, K.; Hasinoff, M. D.; Johnson, D. L.; Lim, B.; Snover, K. A. Jun 1973.
In annual report, 1973.

26119 (RLO-1388-221, pp 103-107) LOW ENERGY PROTON CAPTURE BY ^{12}C AND THE APPLICATION OF A COUPLED-CHANNELS APPROACH TO ITS DESCRIPTION. Ebisawa, K.; Johnson, D. L.; Liu, K. L.; Wieman, H. Jun 1973.
In annual report, 1973.

26120 (RLO-1388-221, pp 107-110) STUDY OF THE REACTIONS $^{12}C(\alpha,\alpha'\gamma_{15.1+12.7})^{12}C^*$ AND $^{10}B(\alpha,d'\gamma_{15.1+12.7})^{12}C^*$. Hasinoff, M.; Lim, S. T.; Measday, D. F.; Mulligan, T. J.; Spuller, J. E. Jun 1973.
In annual report, 1973.

26121 (RLO-1388-221, pp 111-113) $^{12}C(\alpha,\gamma_0)^{16}O$ REACTION. Adelberger, E. G.; Brown, D. R.; Lim, B.; Snover, K. A. Jun 1973.
In annual report, 1973.

26122 MUON CAPTURE IN ^{16}O AND NUCLEAR COEXISTENCE. Nalcioglu, O. (Univ. of Rochester, NY); Goswami, A.; Graves, R. D. Lett. Nuovo Cim.; 7: No. 17, 897-901(25 Aug 1973).

It is shown that the nuclear shape coexistence can resolve most of the experimental–theoretical discrepancies for muon capture on oxygen-16. It is assumed that the weak-interaction part of the process is known better than the nuclear-structure part, and the muon-minus capture process is used for obtaining information about the nuclear wave functions. Previous calculations are extended to $J^\pi = 0^-, 1^-, 2^-, 3^-$, T = 1 states, and the ground state correlations due to phonon excitations are included. The total and partial capture rates to 0^-, 1^-, 2^-, and 3^- states are found. (JFP)

26123 ROLE OF SHORT-RANGE CORRELATIONS IN THE NUCLEAR PHOTOEFFECT. Malecki, A. (Instytut Fizyki Jadrowej, Krakow); Picchi, P. Lett. Nuovo Cim.; 8: No. 1, 16-20(1 Sep 1973).

The effects of short-range correlations on nucleon emission from photon reactions with oxygen-16 are considered. A very simple model is used in which the photon interacts with individual nucleons with a given momentum distribution. The impulse approximation is used. Momentum and angular distributions and the integrated cross section are found. (JFP)

26124 PARTIAL TRANSITIONS IN MUON CAPTURE BY COMPLEX NUCLEI. II. The Gamma–Neutrino Correlation. Bukhvostov, A. P.; Ciechanowicz, S.; Dogotar, G. E.; Eramzhyan, R. A.; Popov, N. P.; Vartanjan, V. A. (Joint Inst. for Nuclear Research, Dubna, USSR). Acta Phys. Pol.; B4: No. 4, 495-500 (1973).

The gamma-neutrino directional angular distribution is calculated for the muon capture in ^{10}B and in ^{15}N. The dependence on nuclear structure and induced pseudoscalar coupling is investigated. A detailed analysis of the independent multipole amplitudes which describe the transition in ^{15}N to the first excited level of ^{15}C is also given. (auth)

26125 SPIN EXCHANGE POLARIZATION AND MEASUREMENT OF THE HYPERFINE SPLITTING OF SHORT-LIVED ^{8}Li. Neugart, R. (Univ., Heidelberg). Z. Phys.; 261: No. 3, 237-248(1973).

Free $^{8}Li(T_{½} = 0.84$ sec) atoms were polarized by spin exchange with optically pumped rubidium vapor. The ^{8}Li nuclei were produced by the reaction $^{7}Li(d,p)^{8}Li$ in a thin LiF target. They recoiled into helium which was used as a buffer gas for optical pumping as well. Nuclear polarization up to 2% was detected by β-decay asymmetry. Rf transitions between hfs levels of the atomic ground state yielded the hfs separation ΔW = 382.543(7) MHz. The nuclear spin assignment I = 2 was confirmed. (10 figures) (auth)

26126 ELASTIC SCATTERING OF ^{15}N ON ^{19}F, ^{19}F ON ^{18}O, AND ^{19}F ON ^{16}O AT LOW ENERGIES AND ELASTIC TRANSFER. Gamp, A.; von Oertzen, W.; Bohlen, H. G.; Feil, M.; Walter, R. L.; Marquardt, N. (Max-Planck-Institut fuer Kernphysik, Heidelberg). Z. Phys.; 261: No. 4, 283-304(1973).

Angular distributions of the elastic scattering in the range of 30–160° cm angles have been measured for the systems $^{15}N + ^{19}F$, $^{19}F + ^{16}O$ and $^{19}F + ^{18}O$ at three energies, the highest being approximately 4 MeV above the Coulomb barrier. The large differences observed in the structure of the angular distributions at large angles are discussed; elastic transfer and the angular momentum balance for the possible direct surface reactions are taken into consideration. The analysis yields a consistent description of the data in terms of elastic transfer. (14 figures, 1 table) (auth)

26127 CONTINUUM NUCLEAR STRUCTURE OF ^{12}C IN THE COLLECTIVE CORRELATION MODEL. Mshelia, E. D. (Univ., Frankfurt am Main); Barrett, R. F. Z. Phys.; 261: No. 4, 313-328(1973).

On the basis of the Collective Correlation Model the giant dipole resonance of ^{12}C is investigated; the one-particle continuum states are treated in the framework of the eigenchannel theory of nuclear reactions. Total, partial and integrated photo-reaction cross-sections are calculated; the low-lying negative-parity energy states of the mass-11 nuclei are properly taken into account. (6 figures, 2 tables) (auth)

26128 EXPERIMENTAL EVIDENCE FOR α-PARTICLE DOORWAY STATES IN THE $^{12}C+^{12}C$ REACTION. Voit, H.; Ischenko, G.; Siller, F. (Physikalisches Institut der Universität Erlangen–Nürnberg, Erlangen, Germany). Phys. Rev. Lett. 30: No. 12, 564-567 (19 Mar 1973).

Quartet states in ^{20}Ne are preferentially populated in the reaction $^{12}C(^{12}C,\alpha)^{20}Ne$ at $E_{c.m.}$ = 5.7, 6.0, and 6.3 MeV. This may be due to α-particle doorway states having a large overlap with quartet states in ^{20}Ne. The interpretation of the correlated resonances in the $^{12}C+^{12}C$ system as intermediate structure resulting from α-particle doorway states is supported by the results of the measurement reported. (auth)

26129 $^{13}C(^{7}Li,p)^{19}O$ REACTION AND THE SPINS OF LOW-LYING STATES IN ^{19}O. Wiza, J. L.; Bingham, H. G.; Fortune, H. T. (Physics Department, University of Pennsylvania, Philadelphia, Pennsylvania 19174). Phys. Rev. C 7: No. 6, 2175-2178(June 1973).

Low-lying levels of ^{19}O were populated by the $^{13}C(^{7}Li,p)^{19}O$ reaction at a bombarding energy of 16.0 MeV. Angular distributions were measured for all states below 3.3 MeV in excitation energy. The shapes of these angular distributions and the (2J + 1) dependence of the integrated cross sections are consistent with a compound-nucleus mechanism for the reaction. The measured cross section for the level at 3.235 MeV suggests that it has a spin of 3/2 rather than 1/2. (auth)

26130 THREE-NEUTRON PICKUP REACTION ON ^{13}C. Kashy, E.; Benenson, W.; Proctor, I. D.; Hauge, P.; Bertsch, G. (Cyclotron Laboratory, Physics Department, Michigan State University, East Lansing, Michigan 48823). Phys. Rev. C 7: No. 6, 2251-2256 (June 1973).

Angular distributions of ^{6}He particles from the three-neutron pickup reaction $^{13}C(^{3}He, ^{6}He)^{10}C$ have been measured for transitions to the two lowest states of ^{10}C, the $J^\pi = 0^+$ ground state and 3.35-MeV $J^\pi = 2^+$ state. Observed anomalies in the shapes and magnitudes of these distributions cannot be explained theoretically by zero-range distorted-wave Born-approximation calculations. (auth)

26131 ELECTROEXCITATION OF ^{9}Be LEVELS IN THE 14–18-MeV REGION. J. C. Bergstrom; Auer, I. P.; Ahmad, M.; Kline, F. J.; Hough, J. H.; (and others) (Saskatchewan Accelerator Laboratory, University of Saskatchewan, Saskatoon, Canada S7N OWO). Phys. Rev. C 7: No. 6, 2228-2238 (June 1973).

The form factors for electroexcitation of the lowest T = 3/2 levels in ^{9}Be (14.39 MeV,3/2$^-$; 16.97 MeV,1/2$^-$) have been measured for momentum transfers between 0.5 and 1.1 fm^{-1}. Results are also presented for levels of unknown TJ^π at 16.63 and 17.48 MeV excitation. Radiative widths have been extracted. The form factor of the 16.63-MeV state is compared with simple-spherical and deformed shell-model form factors. The ground-state r.m.s. radius and quadrupole moment have been deduced from the elastic scattering data. (auth)

26132 α-CLUSTER WAVEFUNCTIONS FOR THE VIRTUAL DECAYS $^{16}O \rightarrow \alpha + ^{12}C$ AND $^{12}C \rightarrow \alpha + ^{8}Be$. Coelho, H. T. (Physics Department, University of Pennsylvania, Philadelphia, Pennsylvania 19104). Phys. Rev. C 7: No. 6, 2340-2346 (June 1973).

Assuming an α-cluster structure of ^{16}O and ^{12}C, we construct ground-state wave functions (gsw) for ^{16}O and ^{12}C. We expand the gsw of ^{16}O in a product basis of ^{12}C (3α) states and relative motion of the fourth α particle with respect to ^{12}C. A corresponding expansion is used for the ^{12}C ground state. From those expansions, we get the probability amplitudes for intermediate states of ^{12}C and ^{8}Be. Those are compared with the amplitudes extracted from other calculations. Best choices of coordinate systems for the description of the virtual breakups are discussed using the concept of "democracy". (auth)

26133 ^{18}O EXCITATION ENERGIES AND LIFETIMES FROM Ge(Li) MEASUREMENTS IN THE $^{19}F(t,\alpha\gamma)^{18}O$ REACTION. Olness, J. W.; Warburton, E. K. (Department of Physics, Brookhaven National Laboratory, Upton, New York 11973); Becker, J. A. Phys. Rev. C 7: No. 6, 2239-2251 (June 1973).

Ge(Li) spectrometry has been used to study the γ-ray deexcitation of states of ^{18}O produced in the $^{19}F(t,\alpha)^{18}O^*$ reaction at $E_t = 2.6$ MeV. Precision excitation energies were determined from both singles and coincidence measurements. Multiparameter data collection techniques were used to store γ-ray spectra measured at $\theta_\gamma = 0$, 45, and 90° in coincidence with α groups populating various final states of ^{18}O. α particles were detected in an annular detector at $\theta_\alpha = 180°$, thus defining a narrow cone of forward-going ^{18}O recoils which stopped in the Ni target backings. The observed Doppler shifts were analyzed, via the doppler-shift attenuation method, to determine the lifetimes of the initial γ-emitting states. Resulting excitation energies (in keV) and meanlives (in psec) for the first 15 excited states of ^{18}O are as follows: 1982.16 ± 0.20 ($\tau = 2.9^{+0.9}_{-0.6}$), 3555.07 ± 0.45 (> 4.0), 3634.50 ± 0.40 (1.20 ± 0.20), 3920.6 ± 0.4 (0.024 ± 0.010), 4456.1 ± 0.5 (0.065 ± 0.015), 5098.5 ± 1.2 (0.062 ± 0.025), 5260.4 ± 1.2 (0.12 ± 0.03), 5336.4 ± 0.6 (0.20 ± 0.04), 5377.8 ± 1.2 (< 0.03), 5530.5 ± 0.6 (< 0.025), 6196.3 ± 1.2 (...), 6351.3 ± 0.6 (< 0.035), 6404.4 ± 1.2 (0.03 ± 0.015), 6881.6 ± 1.2 (< 0.025), and 7116.9 ± 1.2 (< 0.025). The angular correlations data for each γ transition were fitted, as a function of θ_γ, in order to determine relative intensities and thus branching ratios. An analysis of the correlation data provides confirmation or support for previously reported conclusions on spin-parity assignments, and in addition restricts possible assignments for the 6351-keV state to J = 1 or 2. These results are compared to previous data on ^{18}O and to theoretical considerations. (auth)

26134 HIGH-ENERGY PROTON PRODUCTION OF ^{3}H, ^{3}He, AND ^{4}He IN LIGHT TARGETS. Kruger, S. T.; Heymann, D. (Departments of Space Science and Geology, Rice University, Houston, Texas 77001). Phys. Rev. C 7: No. 6, 2179-2187 (June 1973).

At 0.6 and 3 GeV, cross sections for the production of H^3, He^3, and He^4 in C and Si were determined, and for the production of H^3 and He^3 in oxygen. At 33 GeV only H^3 : He^3 : He^4 production ratios in C and Si could be established due to a fault in the monitoring. The He^3/He^3 yield of 0.85±0.10 embraces the three target materials throughout the energy range investigated. On the other hand, the He^4/He^3 ratios varied with energy and with target material by up to a factor of 2. Most of the previous H^3 cross-section determinations in carbon are shown to be low by a factor of 2 or 3, apparently because of tritium diffusion from the thermoplastic materials used in the earlier studies. The majority of H^3 cross sections at 600 MeV in targets from helium to bismuth fit the equation $\sigma(A) = 30 \exp(A/100)$, which should be beneficial in predicting unknown cross sections. A trend in the He^4 cross sections as a function of target mass was discernable, but the scatter of the data does not permit making a more detailed examination; no He^3 trend as a function of A is observed. (auth)

26135 EXCITATION OF GIANT MULTIPOLE RESONANCES L = 1, 2, AND 3 IN THE $^{16}O(p,2p)$ REACTION. Geramb, H. V. (Kernforschungsanlage, Juelich, Ger.); Eppel, D. Z. Phys.; 261: No. 2, 177-186(1973).

The $^{16}O(p,2p)$ quasi-elastic reaction at 45 MeV is investigated in the framework of the antisymmetrized distorted-wave approximation. The inclusion of a direct and exchange two-step core polarization mechanism, virtually exciting giant multipole resonances, was consistently applied as in the (p,p') nonnormal-parity transition of ^{16}O. Thus, by utilizing the same renormalized effective two nucleon t-matrix as in the inelastic transition a good fit to the data was obtained. It is suggested by the present analyses that core polarization must be fully included for (p,2p) as for inelastic scattering in the intermediate energy range. (3 figures, 1 table) (auth)

26136 COMMENT ON THE DIRECT NATURE OF ^{6}Li-INDUCED THREE-NUCLEON-TRANSFER REACTIONS. Bingham, H. G.; Fortune, H. T. (Physics Department, University of Pennsylvania, Philadelphia, Pennsylvania 19104). Phys. Rev. C; 7: No. 6, 2602-2604 (June 1973).

Excitation functions for the $^{16}O(^{6}Li,t)$ reaction at 7.5° have been measured in 100-keV steps from 22.0 to 24.6-MeV incident energy. Data for the 0.0-, 0.24+0.27-, 1.51+1.54+1.62-, and 2.79-MeV states exhibit no prominent structure over the energy range studied and are suggestive of a predominantly direct reaction mechanism. (auth)

26137 A LOOK AT THE ^{46}Ca LEVEL STRUCTURE WITH $^{46}Ca(p,p')^{46}Ca$ AT $E_p = 16$ MeV. Daehnick, W. W.; Spisak, M. J. (Nuclear Physics Laboratory, University of Pittsburgh, Pittsburgh, Pennsylvania 15213). Phys. Rev. C 7: No. 6, 2593-2596 (June 1973).

^{46}Ca excitation energies were measured by means of the $^{46}Ca(p,p')$ reaction. Approximately 40 levels below 6 MeV not previously identified in inelastic scattering studies were seen. Over-all experimental resolution was 8 keV. The existence of several close-lying doublets previously postulated to explain apparent conflicts in $^{44}Ca(t,p)^{46}Ca$ and $^{48}Ca(p,t)^{46}Ca$ spin assignments was confirmed. A number of new levels are pointed out as candidates for unnatural parity states. (auth)

26138 NEUTRON SPIN-FLIP IN THE REACTION $^{12}C(n,n')$ $^{12}C^*(4.44$ MeV) AT 15.0 MeV. Thumm, M.; Mertens, G.; Mack, G. (Univ., Tuebingen, Ger.). Naturforsch., a; 28a: No. 7, 1223-1225 (1973).

The spin-flip probability S(Θ) in the inelastic scattering of unpolarized 15.0 MeV neutrons to the first 2^+ state in ^{12}C has been determined at Θ = 140° (lab.) by measuring the scattered neutrons in coincidence with the subsequent 4.44 MeV deexcitation γ-rays emitted normal to the scattering plane. Time-of-flight technique with carbon recoil detection in a plastic scintillator has been used. The neutron spin-flip probability is S = 0.21 ± 0.06. (1 figure) (auth)

26139 RADIATIVE PION CAPTURE BY ^{6}Li AND ^{12}C. Maguire W. C. Washington, DC; Catholic Univ. of America (1973). 90p. University Microfilms Order No. 73-21,739.

Thesis (Ph. D.).

The transition rate for the capture of a pion in an atomic orbital about ^{6}Li and ^{12}C leaving the nucleus in a bound excited state with the emission of a photon is calculated using the impulse approximation. The T-matrix is obtained from the time reversed pion photoproduction amplitude and initial state distortion of the bound pion is taken into account. The branching ratio R for radiative to nonradiative captures is calculated and compared to experimental values. The agreement is excellent if those experimental values are used that have been obtained by direct observation of the emitted gamma ray and if an optical model value for the total 2P absorption width in ^{12}C is used. (auth)

Nuclear Properties and Reactions, 20 ≤ A ≤ 38

Refer also to abstracts 26134, 26155, 26224, and 26247.

26140 (LA-UR-73-1117) PION PRODUCTION FROM NUCLEI. Sternheim, M. M.; Silbar, R. R. (Los Alamos Scientific Lab., N. Mex.). 1973. Contract W-7405-eng-36. 11p. (CONF-730642-8). Dep. NTIS $3.00.

From 5th international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973).

π^+ production by protons from nuclei was calculated using a semiclassical model. The overall agreement with data at 740 MeV is quite good. Ambiguities arising from the nuclear corrections are found to be larger than the effects of moderate variations of the nuclear surface parameters. (auth)

26141 (RLO-1388-221, pp 74-77) $Si(\vec{p},p_0)$ REACTION AND THE DESIGN OF A SILICON POLARIMETER. Baker, M. P.; Cramer, J. G.; Tape, J. W.; Weitkamp, W. G. Jun 1973.

In annual report, 1973.

26142 (RLO-1388-221, pp 91-95) ELASTIC AND INELASTIC SCATTERING OF ^{16}O FROM ^{26}Mg, ^{27}Al, AND ^{28}Si. Cramer, J. G.; DeVries, R. M.; Liu, K. L.; Nair, K. G; Zisman, M. S. Jun 1973.

In annual report, 1973.

26143 (RLO-1388-221, pp 114-115) RADIATIVE PROTON CAPTURE INTO THE GIANT DIPOLE RESONANCE OF ^{29}P. Ebisawa, K.; Hasinoff, M. D.; Lim, S. T.; Measday, D. F.; Mulligan, T. J. Jun 1973.

In annual report, 1973.

26144 ^{7}Be, ^{22}Na, AND ^{24}Na PRODUCTION CROSS SECTIONS WITH 22- TO 52 MeV PROTON ON ^{27}Al. Miyano, K. (Niigata Univ., Japan). J. Phys. Soc. Jap.; 34: No. 4, 853-856(Apr 1973).

Cross sections for the formations of ^{7}Be, ^{22}Na and ^{24}Na from proton bombardment of ^{27}Al were measured. A stack of aluminum

foils was bombarded with 52 MeV protons. The reaction cross sections were calculated from the yields of the characteristic γ rays from the residual activities. Gamma rays were detected with a Ge(Li) detector. The cross sections for the $^{27}Al(p,\alpha d)$ and $(p,\alpha pn)$ reactions near the thresholds were obtained and their absolute values were found to be explained in terms of evaporation process. (auth)

26145 RECOIL PROPERTIES OF ^{27}Mg FROM THE $^{27}Al(\gamma,\pi^+)^{27}Mg$ REACTION. Friberg, B.; Blomqvist, I.; Forkman, B. (Tekniska Hoegskolan, Lund, Sweden). Z. Phys.; 262: No. 3, 255-264(1973).

The mean ranges of the recoil nuclei from the reaction $^{27}Al(\gamma,\pi^+)^{27}Mg$ have been measured at maximum bremsstrahlung energies of 250, 400 and 800 MeV using catcher-foil techniques. The experimentally determined ranges in directions along and perpendicular to the photon beam are in good agreement with calculated values based on the Fermi gas model and the impulse approximation. (5 figures, 2 tables) (auth)

26146 SPECTROSCOPY OF ^{32}P. van Eijkern, F. E. H.; van Middelkoop, G.; Timmer, J.; van Luijk, J. A. (Rijksuniversiteit, Utrecht). (1973). vp.

From spring meeting of the Deutsche Physikalische Gesellschaft, Part A: nuclear physics; Heidelberg, Germany (19 Feb 1973).

Particle–gamma angular correlations have been measured with the $^{29}Si(\alpha,p\gamma)^{32}P$ reaction at bombarding energies E_α = 10.65, 10.69 and 11.00 MeV. Together with DSA (Doppler-shift-attenuation) lifetime measurements these experiments lead to seven unambiguous spin assignments to levels below 3.5 MeV excitation energy in ^{32}P. In addition, the measured mixing ratios and branching ratios yield many dipole and quadrupole transition strengths. The previously known 3.44 MeV level is a doublet with components at 3,443.0 ± 0.6 and 3,444.0 ± 0.9 keV. (9 figures, 3 tables) (auth)

26147 NEW SPECTROSCOPIC MEASUREMENTS VIA EXOTIC NUCLEAR REARRANGEMENT: THE REACTION $^{26}Mg(^7Li, ^8B)^{25}Ne$. Wilcox, K. H.; Jelley, N. A.; Wozniak, G. J.; Weisenmiller, R. B.; Harney, H. L.; (and others) (Lawrence Berkeley Laboratory and Department of Chemistry, University of California, Berkeley, California, 94720). Phys. Rev. Lett. 30: No. 18, 866-869 (30 Apr 1973).

A 79-MeV ^7Li beam and counter–telescope techniques were employed to observe the reaction $^{26}Mg(^7Li, ^8B)^{25}Ne$. The cross section to the ground state was ≈350 nb/sr at forward angles and its Q value was −22.05±0.10 MeV, corresponding to a ^{25}Ne mass excess of −2.18±0.10 MeV. Five excited states were also observed at 1.65±0.05, 2.03±0.05, 3.25±0.08, 4.05±0.08, and 4.7±0.1 MeV. (auth)

26148 SPIN-FLIP PROBABILITY FOR 7.44-MeV NEUTRONS SCATTERED INELASTICALLY (Q = − 1.78 MeV) BY A SILICON TARGET. Steuer, M. F.; Wood, R. M.; McDonald, M. W.; McDaniel, F. D.; Etten, M. P. (University of Georgia, Athens, Georgia 30601). Phys. Rev. C 7: No. 6, 2304-2311 (June 1973).

Spin–flip probability for 7.44–MeV (ΔE = 0.300 MeV) neutrons scattered inelastically (Q = − 1.78 MeV) from naturally occurring silicon has been measured using a γ–correlated neutron time–of–flight method. Measurements of the elastic scattering and both the γ–correlated and non–γ–correlated inelastic scattering were assumed to provide a good approximation to scattering by ^{28}Si. The optical model appears to be applicable in first approximation. The inelastic differential cross section and spin–flip probability data have been compared to calculations which indicate a statistical compound–nucleus contribution of 53% and a direct–interaction (DI) contribution of 47%. The DI contribution was calculated in the distorted–wave Born approximation with: (1) a collective model and (2) a microscopic description of "valence" nucleons plus a core–polarization model. Exchange amplitudes in the microscopic calculation were small but a comparison of the calculation with the spin–flip data suggests that they may be important. The collective–model form factor does not produce agreement with the backward–angle data. The disagreement between theory and experiment suggests that the assumptions made in the analysis are approximate only. (auth)

26149 NEW ALUMINUM ISOTOPE; MASS AND β DECAY OF THE $T_z = 5/2$ NUCLIDE ^{31}Al AND THE MASS OF ^{34}P. Goosman, D. R.; Alburger, D. E. (Brookhaven National Laboratory, Upton, New York 11973). Phys. Rev. C; 7: No. 6, 2409-2417 (June 1973).

The first reported measurements of the β decay, half–life, and mass of ^{31}Al are presented. The new activity was produced by the $^{18}O(^{18}O,\alpha p)^{31}Al$ reaction using 41–MeV incident ^{18}O ions, and was transferred pneumatically to a remotely located station where delayed γ rays and β rays were counted with Ge(Li) and NE 102 detectors, respectively. γ–ray energies (in keV) and relative intensities for the ^{31}Si daughter transitions are 621.81 ± 0.30 (9.94 ± 0.65), 752.23 ± 0.30 (18.5 ± 0.8), 1564.49 ± 0.30 (17.3 ± 1.6), 1694.73 ± 0.30 (58.9 ± 1.6), and 2316.64 ± 0.40 (72.8 ± 1.8). The ^{31}Si excitation energies (in keV) and relative β branching intensities are 752.24 ± 0.30 (< 3.0), 1694.78 ± 0.30 (49.0 ± 1.7), and 2316.73 ± 0.40 (100 ± 2.5). A tentative β–ray transition to a state at E_x = 2787.7 ± 0.8 keV is also observed. Upper limits on the strength of some possible γ–ray transitions following β decay to higher levels are given. ^{31}Al decays with a half–life of 644 ± 25 msec. By measuring the energy spectra of β rays populating the second and third excited states of ^{31}Si, the mass excess of ^{31}Al has been measured to be −15008 ± 100 keV. The mass excess of ^{34}P has been remeasured by a similar technique to be −24550 ± 90 keV, and this value has been used to revise previous predictions for the masses of ^{33}Si and ^{35}P. The masses of several $T_z = 5/2$ and $T_z = 3$ nuclides in the 2s − 1d shell are compared with theoretical estimates. The β–decay measurements for ^{31}Al are shown to be in poor agreement with simple collective-model calculations, and in good agreement with recent detailed shell–model calculations. (auth)

26150 LIFETIME MEASUREMENTS OF LOW–LYING STATES OF ^{33}P. Wagner, P.; Coffin, J. P.; Ali, M. A.; Alburger, D. E.; Gallmann, A. (Laboratoire de Physique Nucléaire et d'Instrumentation Nucléaire, Centre de Recherches Nucléaires et Université Louis Pasteur, Strasbourg, France). Phys. Rev. C 7: No. 6, 2418-2426 (June 1973).

Proton–γ coincidence techniques have been used to measure, by the Doppler–shift attenuation method, the lifetimes of the nine bound states of ^{33}P below 4.3–MeV excitation energy, via the $^{31}P(t,p\gamma)^{33}P$ reaction, at triton bombarding energies of 2.5 and 3.1 MeV. More accurate excitation energies have also been obtained for these states. For the first nine excited states in ^{33}P the measurements lead to the following energies (keV) and lifetimes (psec) : 1431.5 ± 0.3 (0.60 ± 0.10), 1847.3 ± 0.3 (0.80 ± 0.15), 2537.6 ± 0.5 (0.070 ± 0.012), 3275.5 ± 1.0 (0.21 ± 0.04), 3490.2 ± 1.0 (0.11 ± 0.02), 3626.6 ± 1.0 (0.17 ± 0.08), 4048 ± 1 (0.085 ± 0.030), 4194 ± 3 (0.15 ± 0.05), and 4225 ± 1 (0.39 ± 0.10). The decay modes and branching ratios for these states have also been measured. These results restrict the spin and parity of the listed states (MeV) to the following assignments (J^π) : 3.28 ((3/2), (5/2)+), 3.63 ((7/2)+), 4.05 ((5/2)(+)), 4.19 ((5/2)+). For some transitions better limits have been set on the δ mixing ratios previously measured. The ^{33}P spectrum obtained is compared to other results and to applicable shell–model calculations. (auth)

26151 NUCLEAR CAPTURE OF MUONS IN ARGON AND NEON. Bertin, A.; Vitale, A. (Instituto di Fisica dell' Università di Bologna and Istituto Nazionale di Fisica Nucleare, Sezione di Bologna, Italy); Placci, A. Phys. Rev. A 7: No. 6, 2214-2217 (June 1973).

The total nuclear capture rates of muons by argon and neon have been measured. The experiment was performed by stopping negative muons in a target of ultrapure gaseous deuterium (at 6 atm pressure and 293 °K) separately contaminated by small amounts of argon and neon, and observing the differential time distribution of the decay electrons coming from muons stopped within the gaseous mixture. The results are $\lambda_{c,Ar}$ = (1.20±0.08) ×10⁶ sec⁻¹ and $\lambda_{c,Ne}$ = (0.30±0.02) ×10⁶ sec⁻¹. (auth)

26152 DISTORTED–WAVE BORN–APPROXIMATION ANALYSIS OF $^{36,38}Ar(d,p)$ TO NEUTRON RESONANCES IN $^{37,39}Ar$. Coker, W. R. (Center for Nuclear Studies, University of Texas, Austin, Texas 78712). Phys. Rev. C 7: No. 6, 2426-2431 (June 1973).

$^{36,38}Ar$ (d,p) angular distributions at 9– and 10–MeV incident energy, for 13 neutron–unbound states in $^{37,39}Ar$, are described in terms of conventional distorted–wave Born–approximation theory using complex–energy eigenstates as form factors, and spectroscopic information is extracted which is consistent with previous studies of the bound neutron states of $^{37,39}Ar$. (auth)

26153 TOTAL NEUTRON YIELD FROM THE (α,n) REACTION ON $^{21,22}Ne$. Haas, F. X. (Mound Laboratory, Miamisburg, Ohio); Bair, J. K. Phys. Rev. C; 7: No. 6, 2432-2436 (June 1973).

Compound states of high excitation in $^{25,26}Mg$ have been observed, with good resolution, in the total neutron yield from α–particle bombardment of $^{21,22}Ne$. Bombarding energies were from 1 to 5 MeV. Analysis of the areas under the yield curves gives α–particle strength functions of $\bar{S}_\alpha = 0.031 \pm 0.021$ for $^{21}Ne + \alpha$ and $\bar{S}_\alpha = 0.026 \pm 0.012$ for $^{22}Ne + \alpha$. For astrophysical purposes these strength functions are used to extrapolate the averaged cross sections to lower energies. (auth)

26154 EMISSION OF PHOTONEUTRONS FROM ^{29}Si AT PHOTON ENERGIES UP TO 13 MeV. Fukuda, K.; Okabe, S. (Radiation Center of Osaka Prefecture, Sakai, Japan). J. Phys. Soc. Jap.; 34: No. 2, 315-319(Feb 1973).

The photoneutron cross section of ^{29}Si was studied by irradiating silicic anhydride, enriched in ^{29}Si, in the x-ray beam of a 15–MeV linear electron accelerator. The photoneutron cross section shows maxima at about 10.6 and 12.2 MeV. The integrated cross section

from the threshold to 13.0 MeV is 11 MeV · mb. The angular distribution of photoneutrons was also measured to fit with a curve of the form $a + b \sin^2\theta$. The values for b/a are found to be 2.1 ± 1.0 and 3.9 ± 0.8 for measurements with bremsstrahlung having maximum energies of 11.7 and 12.9 MeV, respectively. The significant features of the photoneutron cross section and the angular distribution are discussed and compared with theoretical calculations for the E1 transition of a valence neutron. (auth)

Nuclear Properties and Reactions, 39 ≤ A ≤ 58

Refer also to abstracts 26137, 26151, 26175, 26184, 26186, 26188, 26193, 26247, and 26256.

26155 (INDC(SEC)-31-U, pp 37-50) INELASTIC NEUTRON SCATTERING DATA FROM SOME RECENT MEASUREMENTS. Almen, E.; Holmqvist, B.; Wiedling, T. (Neutron Physics Lab., Studsvik, Sweden). Jan 1973.

In topical discussion on inelastic scattering of fast neutrons.

During the last three years fast-neutron inelastic scattering from twenty elements in the atomic mass region 24 to 209 was measured with high-resolution time-of-flight technique in the energy range 2.0 to 4.5 MeV. These data can give a good background for the proper understanding of the reaction mechanisms and of the usefulness of the nuclear models describing the scattering process. Neutron inelastic scattering from the elements studied was observed, for the most part, at one scattering angle, viz., 125°; the angular distributions were assumed to be isotropic or symmetric around 90°. The validity of this assumption was investigated by observing differential inelastic cross sections at several angles for 3.0 MeV incident neutron energy. Since the inelastic scattering process is characterized mainly by compound nucleus formation in the energy range investigated, the experimental data were interpreted in terms of the Hauser and Feshbach statistical model corrected according to Moldauer for level width fluctuations and resonance-interference effects. The transmission coefficients were calculated by using a local optical potential including a spin–orbit interaction term. For most elements analyzed so far good agreement with the experimental data is obtained by taking the above-mentioned corrections into account and assuming many overlapping levels in the compound nucleus. The pure Hauser–Feshbach model can overestimate the cross sections by as much as a factor of 2 at low primary energies, where the statistical assumptions of the compound nucleus are not valid and only a few decay channels are available. (11 figures) (auth)

26156 (RLO-1388-221, pp 61-64) STUDY OF THE QUASI-ELASTIC (p,n_A) REACTION. Baker, M. P.; Hasinoff, M.; Johnson, D. L.; Wieman, H. Jun 1973.

In annual report, 1973.

26157 (RLO-1388-221, pp 65-66) RELATIVE NEUTRON AND PROTON DISTRIBUTIONS OF ^{48}Ca AS DEDUCED FROM THE ELASTIC SCATTERING OF ALPHA PARTICLES FROM ^{40,48}Ca. Blair, J. S.; Ebisawa, K.; Sumner, W. Q. Jun 1973.

In annual report, 1973.

26158 (RLO-1388-221, pp 78-80) ASYMMETRY OF POLARIZED PROTONS INELASTICALLY SCATTERED FROM ^{40}Ca AND ^{48}Ca. Baker, M. P.; Blair, J. S.; Bussoletti, J. E.; Preikschat, E.; Tape, J. W.; Weitkamp, W. G. Jun 1973.

In annual report, 1973.

26159 (RLO-1388-221, pp 115-118) ^{39}K(p,γ)^{40}Ca AND THE SEARCH FOR ΔT = 2 ELECTROMAGNETIC TRANSITIONS. Adelberger, E. G.; Cooper, M. D.; Marrs, R. E.; Snover, K. A. Jun 1973.

In annual report, 1973.

26160 ANALYSIS OF ALPHA INELASTIC SCATTERING IN THE CONTINUUM. Demeyer, A.; Chevarier, A.; Chevarier, N.; Hollinger, G.; Petrosa, P.; Tran Minh Duc (Univ. Claude Bernard, Lyon). Lett. Nuovo Cim.; 7: No. 17, 936-940(25 Aug 1973).

The analysis of inelastic scattering in the continuum can include the very excited and statistical states and give information concerning their distortion. The (α,α') angular distributions were analyzed by using a direct interaction mechanism and the distorted-wave approximation with a collective-model form factor. Alpha spectra induced by 54.8-MeV incident alpha particles are measured on several targets from vanadium-51 to lead-206 mass range. Energy spectra, angular distributions, and the mean deformation parameter are obtained. (JFP)

26161 HYPERFINE-FIELD MEASUREMENTS ON Sc IN Fe AND Re IN Ni. Gupta, D. K.; Singhvi, A. K.; Sanwal, D. N.; Rao, G. N. (Department of Physics, Indian Institute of Technology, Kanpur, India). Phys. Rev. B 7: No. 7, 2942-2947 (1 Apr 1973).

The hyperfine fields (H_{hf}) at ^{44}Sc nuclei in an iron matrix and at ^{187}Re nuclei in a nickel matrix are measured at room temperature using time differential perturbed (γ–γ) angular correlation technique (TDPAC). The values obtained are H_{hf} ^{44}ScFe(300°K) = −94 ± kOe and H_{hf} ^{187}ReNi(300 °K) = −107 ± 3 kOe. An external magnetic field of a few kOe was applied to polarize the host matrices of iron and nickel. Using the same TDPAC technique, the magnetic moments of the 68-keV state in ^{44}Sc and of the 2-6-keV state in ^{187}Re are measured. The values obtained are +(0.345 ± 0.007) μ_N and +(5.04 ± 0.14) μ_N, respectively. The measured hyperfine-field values are compared with the predicitons of the existing models. (auth)

26162 STUDY OF ^{57}Co WITH THE ^{57}Fe(p,n)^{57}Co REACTION. Pietrzyk, P.; Buechs, K. D.; Finckh, E.; Fritsch, W.; Schreiber, B. (Hahn-Meitner-Institut fuer Kernforschung), Berlin). Z. Phys.; 262: No. 3, 239-245(1973). (In German).

A neutron time-of-flight investigation of the ^{57}Fe(p,n)^{57}Co reaction performed at bombarding energies of 4.9, 5.6 and 6.2 MeV results in new energy levels of ^{57}Co. In addition, gamma spectra and n–γ coincidence spectra were taken to complete the decay scheme of ^{57}Co up to an excitation energy of 4 MeV. (2 figures) (auth)

26163 PROPERTIES OF γ-RAY TRANSITIONS IN ^{56}Co FROM ^{56}Ni DECAY AND ^{56}Fe(p,nγ)^{56}Co. Samuelson, L. E.; Kelley, W. H.; Todd, R. R. (Cyclotron Laboratory, Department of Physics, Michigan State University, East Lansing, Michigan 48823); Warner, R. A.; McHarris, W. C.; (and others). Phys. Rev. C 7: No. 6, 2379-2409 (June 1973).

The ^{56}Ni ε decay and the ^{56}Fe(p,nγ)^{56}Co reaction with beam energies between 5.5 and 8.4 MeV have been used with Ge(Li) spectrometers to study the properties of γ rays from states of ^{56}Co below 2.86 MeV excitation. From ^{56}Ni ε decay both the γ-ray spectrum and γ-γ coincidences were studied. γ-γ coincidences, γ-ray excitation functions, γ-ray angular distributions, and absolute cross sections were measured for the ^{56}Fe(p,nγ)^{56}Co reaction. An ε decay scheme for ^{56}Ni, which includes six γ rays, and an energy-level diagram for ^{56}Co, which includes 35 γ rays (14 of which are reported for the first time) from 20 excited states, are presented. Comparisons of the data from ^{56}Fe(p,nγ)^{56}Co with predictions of the statistical compound-nuclear model have resulted in spin assignments (in parentheses) for the following states (energies in keV) of ^{56}Co: 158.4(3), 576.6(5), 829.7(4), 970.3(2), 1009.2(5), 1114.6(3), 1450.8(0), and 1720.3(1). Branching ratios are presented for 14 γ rays from these eight states and multipole mixing ratios are given for 12 of these γ rays (10 are predominantly M1). The data are consistent with a spin-4 assignment to the ground state. Contrary to previous suggestions, evidence from all experiments indicates that only one state (believed to be the antianalog of the ^{56}Fe ground state) exists in ^{56}Co in the neighborhood of 1451 keV excitation. The level energies, γ-ray multipole mixing ratios, and γ-ray branching ratios agree, in general, with shell-model predications of McGrory. (auth)

26164 SHELL-MODEL STUDY OF THE CALCIUM ISOTOPES (A = 42-48) USING A PAIRING-PLUS-SURFACE-TENSOR INTERACTION. Banerjee, D.; Oberlechner, G. (Department de Physique Nucleaire Theorique, Centre de Recherches Nucleaires, Strasbourg, France.). Phys. Rev. C 7: No. 6, 2437-2452 (June 1973).

The calcium isotopes ^{42}Ca through ^{48}Ca are described within the framework of the conventional shell model using a phenomenological effective two-body interaction. The residual interaction consists of usual j–j pairing plus a surface-tensor force. ^{40}Ca is assumed to be an inert core. Besides all possible configurations arising from $1f_{7/2}$ and $2p_{3/2}$ orbits, configurations of the form $(1f_{\frac{7}{2}})^{n_1}(1f_{\frac{3}{2}})^{n_2}$, where $n_1 + n_2 = n$ n (the number of extracore neutrons) and $n_2 = 1, 2$, are also considered in the basis vector spaces. The calculated ground-state energies as well as the excited energy levels are in good agreement with the experimental values. Reproduction of single-neutron spectroscopic factors for stripping and pickup reactions is also good. (auth)

26165 INTERACTION OF 3- AND 29-GeV PROTONS WITH VANADIUM. Husain, L. (Chemistry Department, Brookhaven National Laboratory, Upton, New York 11973); Katcoff, S. Phys. Rev. C 7: No. 6, 2452-2461 (June 1973).

Yields for 43 nuclides have been determined in the interaction of 3- and 29-GeV protons with V. Most of the radionuclides were measured by direct γ-ray spectroscopy of the irradiated targets; stable Ne and Ar isotopes were measured by mass spectrometry; radioargon isotopes were determined both mass spectrometrically and by radioactivity measurements. Charge dispersion curves were derived from independent and cumulative yield measurements for the mass regions 22-29, 36-41,

and 42–48. The curves for 29 GeV are almost identical with the corresponding ones for 3 GeV. Total isobaric cross sections were determined at many mass numbers by estimating the unmeasured cross sections, from the charge dispersion curves, and adding them to the directly measured ones. Thus mass-yield distributions were obtained. At 3 GeV the total isobaric cross section is 30 mb at mass 47 and it decreases to a minimum of 8 mb around mass 24. At 29 GeV the cross sections are slightly lower than at 3 GeV for the heavier products, down to about mass 30, and somewhat higher for the lighter products, below mass 30. The mass-yield distributions from V are similar to those determined from Cu and Ag. It is shown that the experimental results (including those from Cu) do not agree as well with the Monte Carlo cascade calculations of Metropolis et al., as has been generally supposed. (auth)

26166 STUDY OF ^{58}Co WITH THE (^{3}He,p) AND (^{3}He,pγ) REACTIONS ON ^{56}Fe. Hardie, G. (Western Michigan University, Kalamazoo, Michigan 49001); Braid, T. H.; Meyer-Schützmeister, L.; Smith, J. W. Phys. Rev. C 7: No. 6, 2466-2475 (June 1973).

Thirty levels in ^{58}Co were populated by use of the ^{56}Fe(^{3}He,p) reaction. The angular distributions of protons leading to these states were obtained with a split-pole magnetic spectrograph. In some cases a study of the angular distribution permitted the determination of the orbital angular momentum transferred by the n–p pair. Coincidences between protons and γ rays from the ^{56}Fe(^{3}He,pγ) reaction were also studied to obtain the γ decay of some levels in ^{58}Co. The results of the present investigation are combined with those of previous work on ^{58}Co to assign spins and parities for some of the levels. The isobaric analog to the ground state of ^{58}Fe and the corresponding antianalog state are briefly discussed. (auth)

26167 LIFE-TIME OF THE 6$^+$ STATE IN ^{50}Ti. Gil, C. (Tokyo Univ.). J. Phys. Soc. Jap.; 34: No. 3, 571-574(Mar 1973).

The lifetime of the 6$^+$ state in ^{50}Ti was measured by means of the beta-gamma delayed coincidence method in the decay of ^{50}Sc, produced by the 14 MeV neutron bombardment of natural titanium. The 520 keV (6$^+ \rightarrow 4^+$) γ-ray from the 3197 keV level in ^{50}Ti was found to decay with a half-life $T_{1/2} = 0.41 \pm 0.02$ ns. An experimental B(E2) value of $36 \pm 2e^2$ fm^4 is hence obtained as well as a value for the polarization charge similar to that of ^{42}Ca, leading to the conclusion that the polarization charge has nearly the same value for both the $f_{7/2}$ proton and neutron. (auth)

26168 FIT OF THE ANALOG RESONANCES IN ^{40}Ti. Lukasiak, A.; Zych, W. (Inst. of Nuclear Research, Warsaw). Acta Phys. Pol.; B4: No. 4, 489-494(1973).

Calculations concerning some of the resonances in the excitation curve ^{45}Sc(p,p) in the energy range of incident protons E_p 1.6 to 1.8 MeV are presented. Four resonances are considered as analog ones in the compound nucleus ^{46}Ti. (2 figures, 2 tables) (auth)

26169 DECAY OF ^{56}Mn. Ardisson, G.; Marsol, C.; Armanet, F. (Univ., Algiers). Radiochem. Radioanal. Lett.; 14: No. 5-6, 317-322(5 Sep 1973). (In French).

The decay of ^{56}Mn was reinvestigated using a coaxial Ge (Li) diode. γ rays of 2598 and 1238 keV were confirmed. A 3119-keV line reported elsewhere was not found. A ^{56}Fe level scheme is proposed. (2 figures, 1 table) (auth)

Nuclear Properties and Reactions, 59 ≤ A ≤ 89

Refer also to abstracts 24570, 26140, 26155, 26160, 26184, 26187, 26190, 26193, 26201, 26224, 26232, and 26247.

26170 (RLO-1388-221, pp 77-78) ANALYZING POWER IN THE ^{89}Y($\vec{p}$, p$_0$)^{89}Y REACTION NEAR THE d$_{5/2}$ ISOBARIC SPIN DOUBLET. Baker, M. P.; Preikschat, E. Jun 1973.

In annual report, 1973.

26171 DECAY OF ^{65}Ge. Jongsma, H. W. (Vrije Univ., Amsterdam); de Lange, J. C.; Verheul, H.; de Boer, F. W. N.; Goudsmit, P. F. A. Z. Phys.; 262: No. 3, 247-253(1973).

Energies and relative intensities of γ-rays from the decay of ^{65}Ge have been measured. The half-life was measured to be (31.2 ± 0.7) sec. From the measured intensity of the annihilation radiation the intensity of the ground-state β^+ feeding was determined to be <10%. A total of 31 γ transitions was placed in a level scheme. The spin and parity of the ground state of ^{65}Ge was determined to be $\frac{3}{2}^-(\frac{5}{2}^-)$. (2 figures, 1 table) (auth)

26172 INVESTIGATION OF INTERNAL ISOSPIN MIXING OF ISOBARIC ANALOG RESONANCES FROM POLARIZED-PROTON EXPERIMENTS. Graw, G.; Kretschmer, W. (Physikalisches Institut der Universität Erlangen–Nrnberg, Erlangen, Germany). Phys. Rev. Lett. 30: No. 15, 713-715 (9 Apr 1973).

The lowest analog resonances in ^{89}Y, ^{90}Zr, ^{91}Nb, and ^{93}Nb have been investigated with polarized protons. The consistent fit of the direct and compound-nucleus contributions to both resonance and background scattering for the elastic proton and the neutron decay channels yields an internal spreading width $\Gamma_{int}^{\downarrow} = 12 \pm 3$ keV. (auth)

26173 TWO-HOLE MULTIPLETS IN ^{88}Y FROM ^{89}Y(d,t) AND ^{90}Zr(d,α) STUDIES. Daehnick, W. W.; Bhatia, T. S. (Nuclear Physics Laboratory, University of Pittsburgh, Pittsburgh, Pennsylvania 15213). Phys. Rev. C 7: No. 6, 2366-2379(June 1973).

States of ^{88}Y up to 2 MeV in excitation were studied with 8–12-keV resolution by (d,t) and (d,α) experiments, and interpreted in terms of two-hole configurations. ^{89}Y(d,t) angular distribution and spectroscopic factors were obtained at 14.0- and 15.75-MeV bombarding energy. Six low-lying levels not detected in earlier (^{3}He,α) experiments were resolved. The summed spectroscopic (C^2S) strength obtained for the five strong l=1 transitions was 2/3 of the sum-rule limit in contrast to previous (^{3}He,α) results which exceeded it. Successful distorted-wave Born-approximation (DWBA) predictions for ^{90}Zr(d,α)^{88}Y angular distributions permitted the assignment of 15 L values and corresponding J^π limits for the final states, about half of which had not been resolved in previous particle-transfer work. Levels dominated by $(f_{5/2}g_{9/2})^{-1}$ and $(p_{3/2}g_{9/2})^{-1}$ configurations were identified by comparison with previous data for ^{86}Rb. Higher-spin states dominated by the $g_{9/2}^2$ configuration were not seen, as expected; however, a comparison of measured and "absolute" microscopic DWBA cross sections for known two-hole states showed evidence of strong configuration mixing. Additional evidence for a 2$^-$,(2+) doublet at 706 keV excitation was found. (auth)

26174 ANALYSIS OF THE ANOMALY IN THE REACTION ^{88}Sr(d,p$_0$)^{89}Sr USING POLARIZED DEUTERONS AT THE THRESHOLD OF THE NEUTRON ANALOG CHANNEL. Graw, G.; Stach, W.; Gaul, G.; Hategan, C. (Physikalisches Institut der Universität Erlangen–Nürnberg, 8520 Erlangen, Germany). Phys. Rev. Lett. 30: No. 20, 989-992 (14 May 1973).

The theory of Lane for the anomaly in the excitation function of the (d, p$_0$) reaction near the threshold of the analog (d, n) channel has been applied to polarized-beam measurements. The anomaly effects, observed at several angles in both cross section and analyzing power in the reaction ^{88}Sr(d, p$_0$)^{89}Sr, are reproduced by a distorted-wave Born-approximation calculation, if the radial matrix elements for the proton exit channel with l=1, j=3/2 are modified by a resonance term. (auth)

26175 SELF-CONSISTENT CORE-PARTICLE COUPLING METHOD APPLIED TO THE NICKEL ISOTOPES. Wu, C. (Department of Physics, University of Victoria, Victoria, British Columbia, Canada). Phys. Rev. C 7: No. 6, 2461-2465 (June 1973).

A self-consistent core-particle coupling method derived from the generalized Hartree-Fock approximation was applied to the nickel isotopes. The 0$^+$ ground and 2$^+$ first excited states of the even nickel isotopes are considered as cores, and the low-lying states of the odd nickel isotopes as well as the even core states are calculated self-consistently from the equation of motion in a particle-number nonconserving approximation. The static electric quadrupole moments of the first excited 2$^+$ states, the spectroscopic factors for pickup and stripping reactions on the even targets, and energies of low-lying states of the odd isotopes are calculated and compared with experiments. (auth)

26176 (d,t) REACTIONS ON N = 50 NUCLEI. Takeda, S. (Inst. of Physical and Chemical Research, Wako, Japan). J. Phys. Soc. Jap.; 34: No. 2, 304-314(Feb 1973).

Angular distribution of tritons in (d,t) reactions induced by 21.4-MeV deuterons on ^{88}Sr, ^{89}Y, ^{90}Zr and ^{92}Mo targets was measured to obtain the l-values and the spectroscopic factors of transitions. In the reaction on ^{88}Sr, all of the expected spectroscopic strengths for $T_<$ states are found for the transitions leading to $1g_{9/2}$, $2p_{1/2}$, $2p_{3/2}$, and $1f_{5/2}$ shell-model states. In contrast with this situation, severe fragmentation of the strength as a function of proton numbers was found in the other isotones. Any apparent spectra for $1f_{5/2}$ neutron shell-model orbit were not observed so characteristic as for $1g_{9/2}$, $2p_{1/2}$, $2p_{3/2}$ or $1f_{5/2}$ orbits. The shell-model forbidden l = 2 transitions to $(2d_{5/2})^{-1}$ states were observed in the ^{89}Zr and ^{91}Mo nuclei. From these strengths the amount of shell-model impurities in the ground-state correlation of the target N = 50 nuclei is estimated as a function of proton numbers. (auth)

26177 FISSION OF EMULSION NUCLEI AT HIGH ENERGY DISINTEGRATION. Deka, G. C.; Talukdar, G. N. (Cotton Coll., Gauhati, India). J. Assam Sci. Soc.; 13: 84-86(1970).

In a systematic search for nuclear fission, 1151 disintegrations initiated by 17.2 GeV/c π^--mesons were examined closely. Of these 80 stars were found having their prongs anisotropically distributed.

In some of these the anisotropy was so much that a star took a clear dumb-bell shape, leading to the belief of "two center" production mechanism of the evaporated particles, this means that the struck nucleus first undergoes fission, and then these fragments evaporate the secondary particles. (auth)

26178 (d,^{6}Li) REACTION ON ^{64,66,68}Zn ISOTOPES AT 27.25 MeV. Ceballos, A. E.; Erramuspe, H. J.; Ferrero, A. M. J.; Sametband, M. J.; Testoni, J. E.; Bes, D. R.; Maqueda, E. E. (Comision Nacional de Energia Atomica, Buenos Aires). Nucl. Phys.; A208: 617-625(1973).

The differential cross sections for the reactions ^{64,66,68}Zn(d,^{6}Li)^{60,62,64}Ni leading to the ground 0^+ and the first 2^+ excited states of the residual nuclei are measured at 27.25 MeV. A DWBA analysis is performed using both phenomenological and microscopic form factors. The latter are calculated on the basis of the BCS plus RPA description of the initial and final nuclear states. (auth)

26179 YIELDS OF ^{68}Ge IN IRRADIATION OF GALLIUM BY PROTONS AND DEUTERONS AND IRRADIATION OF ZINC BY α-PARTICLES. Dmitriev, P. P.; Krasnov, N. N.; Molin, G. A.; Panarin, M. V. At. Energ. (USSR); 33: No. 3, 774(Sep 1972). (In Russian).

This paper was summarized as paper No. 605/6775 with full copy held by TIC.

Dependences of yields of ^{68}Ge on the energy of bombarding particles in the irradiation of thick gallium and zinc targets by charged particles from the deflected beam emitted by the FÉI [Physics and Engineering Institute] cyclotron were measured. The activity of the ^{68}Ge was measured on the basis of annihilation radiation emitted by its daughter ^{68}Ga (yield 1.76 photon/decay event). The procedure followed in measuring the yields is similar to that described previously. (auth)

26180 200-GeV PROTONS ON COMPLEX NUCLEI. Butt, J. E.; King, D. T. (Univ. of Tennessee, Knoxville). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 12, 121-125(1973).

From conference on high energy particle interactions; Nashville, TN (26 Mar 1973).

Data on 314 nuclear collisions of 200-GeV protons in emulsion have been collected by following along 103 m of beam track. Those collisions which show no associated nuclear evaporation are found to comprise 21± 3% of the total, and the rise in occurrence of such "white" stars with increasing incident energy is discussed. The significance of white stars with odd multiplicity is examined together with crude results on the odd/even ratio. Six observations interpreted as direct electron pair production by beam protons are described. The cross section measurement, 7.4 ± 0.3 mb, is found to be much smaller than the ~100 mb calculated for 200-GeV proton tridents in emulsion, from quantum electrodynamics. (auth)

26181 200 GeV PROTON INTERACTIONS IN NUCLEAR EMULSION. Hebert, J. (Univ. of Ottawa); Hebert, C. J. D.; Areti, H. AIP (Amer. Inst. Phys.) Conf. Proc.; No. 12, 131-140(1973).

From conference on high energy particle interactions; Nashville, TN (26 Mar 1973).

The mean-free-path for inelastic interactions of 200 GeV protons in nuclear emulsion was measured using the techniques of along-the-track scanning and area scanning. The results obtained are, respectively, $\lambda_{inel} = 35.3 \pm 1.0$ cm and $\lambda_{inel} = 33.1 \pm 1.5$ cm. The average charged multiplicities were found to be $\langle n_s \rangle = 8.2 \pm 0.2$ for "white" stars and $\langle n_s \rangle = 12.9 \pm 0.15$ for all events. A plot of n_s versus N_h (where N_h is the number of black and grey tracks) shows a linear relation over the region $0 \leq N_h \leq 25$. The Castagnoli method applied to "white" stars overestimates the C.M. energy by ~40%, however, for stars with $N_h \geq 1$, there is good agreement. (auth)

Nuclear Properties and Reactions, 90 ≤ A ≤ 149

Refer also to abstracts 24362, 24575, 25133, 26090, 26160, 26172, 26176, 26177, 26180, 26181, 26186, 26202, 26211, 26224, 26232, and 26256.

26182 (COO-3058-38) LINEAR ACCELERATOR PROJECT. Progress Report, April 1, 1973–June 30, 1973. Gaerttner, E. R. (Rensselaer Polytechnic Inst., Troy, N. Y.). 1973. Contract AT(11-1)-3058. 15p. Dep. NTIS $3.00.

The status of current research on neutron cross sections, experimental and theoretical aspects of reactor physics and engineering, and instrumentation development are briefly described. (1 table) (RWR)

26183 (INDC(SEC)-31-U) TOPICAL DISCUSSION ON INELASTIC SCATTERING OF FAST NEUTRONS. (International Nuclear Data Committee). Jan 1973. 95p. Dep. NTIS (U. S. Sales Only) $6.75.

Eight papers presented at the fifth meeting of the International Nuclear Data Committee are given, along with associated discussion. Separate abstracts were prepared for seven of these papers. The remaining one, Inelastic scattering of neutrons from U-238, has appeared in NSA as 27: 10967. (RWR)

For abstracts of individual papers see: 24549, 26092, 26155, 26184, 26185, 26244, and 26620.

26184 (INDC(SEC)-31-U, 51-67) ANALYSIS OF FAST NEUTRON SCATTERING USING THE COUPLED-CHANNELS THEORY. Tanaka, S. (Japan Atomic Energy Research Inst., Tokai). Jan 1973.

In topical discussion on inelastic scattering of fast neutrons.

The angular distributions of elastically and inelastically scattered neutrons were calculated using the spherical optical model, the statistical theory for compound nuclei, and the coupled-channels theory; and the results were compared with experimental data. The calculations were made for Fe, Ni, Zn, ^{120}Sn, ^{139}La, ^{141}Pr, Gd, Er, and ^{209}Bi in the energy range of about 1.4 to 3.5 MeV, except for Zn. In this case, the calculations were performed up to 8 MeV. All the calculations were based on an optical potential with one set of parameter values, which had been obtained from a comparison of calculation and experimental data for the elastic cross sections of ^{209}Bi. For the elastic angular distributions of Fe, Ni, Zn, ^{120}Sn, ^{139}La, and ^{141}Pr, which were assumed to be vibrational, the results calculated with the coupled-channels theory fit the experimental data far better than those calculated with the straightforward spherical optical potential. The inelastic cross sections for some low-lying levels of these nuclei were also better fitted by adding the results of the coupled-channels calculations to those of the Moldauer calculations. For Gd and Er, which have large deformation parameters, the results of elastic scattering calculated with the coupled-channels theory gave better results than the spherical optical-model calculations, although there were still disagreements between the experimental data and the coupled-channels calculations. The inelastic data for these nuclei have rather large errors; accordingly, it is difficult to deduce clear results. (5 figures, 2 tables) (auth)

26185 (INDC(SEC)-31-U, pp 69-75) STUDY OF ENERGY LEVELS OF ^{120}Sn THROUGH THE (n,n'γ) REACTION. Kikuchi, S.; Sugiyama, Y. Jan 1973.

In topical discussion on inelastic scattering of fast neutrons.

The energy levels of ^{120}Sn were studied by means of the (n,n'γ) reaction in the energy range 2.0 ~ 3.1 MeV. A 20-cm^3 Ge(Li) detector, associated with a pulsed-beam time-of-flight spectrometer, was used to detect γ rays. From the threshold energies of γ-ray production cross sections, the energies of levels were determined. For the purpose of obtaining information about spins and parities of these levels, the γ-ray angular distributions were measured at E_n = 2.3, 2.7, and 3.1 MeV. (4 figures) (auth)

26186 (LA-UR-73-1180) FISSION AND COMPLETE FUSION MEASUREMENTS IN ^{40}Ar BOMBARDMENTS OF ^{58}Ni AND ^{109}Ag. Gutbrod, H.; Plasil, F.; Britt, H. C.; Erkkila, B. H.; Stokes, R. H.; Glann, M. (Los Alamos Scientific Lab., N. MEX). 1973. Contract W-7405-eng-36. 17p. (CONF-730823-19; SM-174/59). Dep. NTIS $3.00.

From third symposium on physics and chemistry of fission; Rochester, New York, USA (13 Aug 1973).

Thin targets of ^{58}Ni and ^{109}Ag were bombarded with 197- and 288-MeV ^{40}Ar ions from the Berkeley SUPER-HILAC. A particle telescope consisting of a gas proportional ΔE counter and a silicon surface barrier E detector was used to measure all reaction products, ranging from elastically scattered argon ions to compound-nucleus evaporation products. Fission fragments and transfer products were also detected. A good separation between fission fragments and other reaction products was possible in the case of the ^{109}Ag + ^{40}Ar reaction. Angular distributions were obtained from 4° to 40° in the laboratory system. Elastic scattering and a ^{252}Cf source were used to obtain energy and angular calibrations. The fission fragment angular distribution was characterized by a $1/\sin\theta$ function, and the integrated fission cross section was found to be 300 and 600 mb for Ar + Ag at 197 and 288 MeV. Results were interpreted in terms of a model in which fission competes with other modes of de-excitation of the compound nucleus, and in which the effects of angular momentum on the fission barrier are taken into account. The implications of this conclusion are discussed. Comparisons are

also made with models for the complete fusion cross section which are based on the contact configuration for the interacting two-body systems. (auth)

26187 (RD/B/M-2669) DATA FOR THE CALCULATION OF GAMMA RADIATION SPECTRA AND BETA HEATING FROM FISSION PRODUCTS (REVISION 3). Tobias, A. (Central Electricity Generating Board, Berkeley (England). Berkeley Nuclear Labs.). Jun 1973. 236p. (CNDC-(73)P4). Dep. NTIS (U. S. Sales Only) $14.00.

A complete set of available data on the properties of the fission products of ^{232}Th, ^{233}U, ^{235}U, ^{239}Pu and ^{241}Pu is presented. The compilation includes schematic representations of the decay chains, giving branching fractions where possible. The data presented cover fission yield, half-life, gamma radiation energy and intensity, thermal neutron capture cross-section, total decay energy, mean beta energy and an estimate of conversion electron + X radiation energy. The gamma radiation spectrum is given, where possible, as the best estimate of the number of photons per 100 disintegrations. (auth)

26188 (RLO-1388-221) ANNUAL REPORT, 1973. (Washington Univ., Seattle. Nuclear Physics Lab.). Jun 1973. 171p. Dep. NTIS $10.75.

Work performed during the year ending April 15, 1973, is described. The report is divided into sections as follows: accelerator development, ion source development, instrumentation and research techniques, detector systems, computer systems, structure of and reactions on light nuclei, nuclear astrophysics, weak interactions, reactions and scattering (A > 16), reactions produced by polarized proton beams, reactions produced by carbon and oxygen ions, gamma rays, fission and fission isomers, atomic physics, medium energy physics, and research performed by user or visitor groups. Lists of personnel and publications are also included. (RWR)

For title listings of selected papers see: 25668–25671, 25771, 26109–26121, 25141–26143, 26156–26159, 26170, 26189–26191, 26217, 26218, 26228, and 26229.

26189 (RLO-1388-221, pp 57-60) HIGHLY INELASTIC DEUTERON SCATTERING. Baker, M. P.; Ebisawa, K.; Halpern, I.; Johnson, D. L.; Wieman, H.; Zisman, M. S. Jun 1973.

In annual report, 1973.

26190 (RLO-1388-221, pp 85-88) ANALYSIS OF THE ^{140}Ce(^{16}O,^{15}N)^{141}Pr, ^{140}Ce(^{18}O,^{17}O)^{141}Ce, AND ^{88}Sr(^{16}O,^{15}N)^{89}Y EXPERIMENTAL EXCITATION FUNCTIONS BELOW AND NEAR THE COULOMB BARRIER. Blair, J. S.; Nair, K. G. Jun 1973.

In annual report, 1973.

26191 (RLO-1388-221, pp 96-97) EXPERIMENTAL INVESTIGATIONS OF THE $^{122,\ 124}$Sn(^{16}O,^{15}N)$^{123,\ 125}$Sb REACTIONS NEAR THE COULOMB BARRIER. Blair, J. S.; Nair, K. G.; Potter, D.; Reisdorf, W. Jun 1973.

In annual report, 1973.

26192 (UCID-16258(Add.)) STATUS REPORT TO USNDC. Anderson, J. D.; Browne, J. C. (California Univ., Livermore. Lawrence Livermore Lab.). 25 May 1973. Contract W-7405-eng-48. 7p. Dep. NTIS $3.00.

Some background comments are offered on report UCRL-74622. a compilation of photoneutron cross-section data obtained with monoenergetic photons from positron annihilation in flight. (RWR)

26193 PRODUCTION AND DECAY PROPERTIES OF SHORT LIVED NUCLEI. Verheul, H. (Univ., Amsterdam). (1973). vp.

From spring meeting of the Deutsche Physikalische Gesellschaft, Part A: nuclear physics; Heidelberg, Germany (19 Feb 1973).

At the Free University in Amsterdam a system consisting of an isotope separator on-line with a cyclotron is especially used to study nuclei in the Ni, Zr and Sn regions to test theoretical predictions concerning the γ-decay transition probabilities. The 3 sec decay of ^{58}Cu and the decay of Ru isotopes produced by (^{3}He,xn) reactions on ^{92}Mo targets were studied. In ^{93}Ru an isomeric state with a half-life of 10 sec was found. By reactions of 28 MeV p on the same target an activity of 3.2 min was observed. The levels of odd isotopes of Ni and Zn are reviewed. The results of the measurement of the half-lives of the three lowest excited states of ^{65}Zn fed in the 15 min decay of ^{65}Ga, produced by (d,n) on ^{64}Zn at 5 MeV, are presented. The decay of some Sb and some Te isotopes was investigated to get more information on the excited states of Sn and Sb isotopes (Z = 50 and 51). The Te activities were produced with (^{3}He,xn) reactions in natural Sn foils. By adjusting the isotope separators on A = 113 and 112, two new activities with half-lives of 1.5 min and 1.8 min, assigned uniquely to ^{113}Te and ^{112}Te, were observed for the first time. (GE)

26194 LIFETIME ESTIMATION OF THE 667.0-keV LEVEL IN ^{131}Xe. Engel, H.; Gerst, E.; Schneider, H. (Univ., Giessen, Ger.). Z. Naturforsch., A; 28: No. 6, 1048(1973). (In German).

Delayed β–γ-coincidence measurements of the 667.0-keV level in ^{131}Xe populated by the decay of ^{131}I were carried out with a plastic–Ge(Li)-detector-combination and resulted in the following $T_{½}$ value of 667.0-keV level in ^{131}Xe: <0.5 ns. (orig.)

26195 MOESSBAUER SCATTERING OF THE 166 keV GAMMA RAYS OF ^{139}La. Wagner, F. E. (Technische Univ., Munich); Thoma, K.; Atoji, M. Z. Phys.; 262: No. 3, 265-270(1973).

The Moessbauer scattering of the 166 keV γ-rays of ^{139}La was observed with a source of ^{139}Ce in CeO_2 and scatterers of La_2O_3, $La(OH)_3$, LaF_3, K_3LaF_6, LaB_6 and LaC_2. The isomer shifts obtained for these compounds are compared with isomer shift data for the analogous Pr compounds. From this comparison it is inferred that the change of the mean square nuclear charge radius for the 166 keV transition is positive and of the order of 10^{-2} fm^2. (1 figure, 1 table) (auth)

26196 COEXISTENCE OF DEFORMED AND SPHERICAL STATES IN ODD-MASS NUCLEI. Mang, H. J. (Technische Univ., Munich); Krmpotic, F.; Abecasis, S. M. Z. Phys.; 262: No. 1, 39-58(1973).

The problem of coexisting deformed and spherical states in odd-mass nuclei is discussed within the framework of the unified model. Emphasis is placed on the coupling between such states. Numerical calculations were performed for ^{115}In. The basic spherical states are either ^{116}Sn plus a (proton) hole or ^{114}Cd plus a (proton) particle. The agreement between calculated and experimental quantities is rather good. (2 figures, 3 tables) (auth)

26197 TWO-PARTICLE–ONE-HOLE STATES IN THE ODD-A ANTIMONY ISOTOPES. Vanden Berghe, G. (Ghent Rijksuniversiteit); Degrieck, E. Z. Phys.; 262: No. 1, 25-37 (1973).

The two-particle–one-hole states experimentally observed in the odd-A antimony isotopes are explained in a particle–core coupling model. The wave functions for these states are discussed. Theoretical and experimental spectroscopic factors for a (d,^{3}He) reaction on the double-even Te isotopes are compared. Electric quadrupole reduced transition probabilities in ^{121}Sb are discussed. (2 figures, 5 tables) (auth)

26198 EVIDENCE FOR WELL-DEVELOPED BAND STRUCTURE IN ^{101}PD. Simms, P. C.; Rickey, F. A.; Tesmer, J. R. (Tandem Accelerator Laboratory, Purdue University, Lafayette, Indiana, 47907). Phys. Rev. Lett. 30: No. 15, 710-713 (9 Apr 1973).

Three γ-ray cascades have been excited in ^{101}Pd by (heavy-ion,xn) reactions. Excitation functions, γ-ray angular distributions, and γ–γ coincidence measurements were used to show that the γ rays came from three bands built on 5+/2, 7+/2, and 11-/2 intrinsic states. (auth)

26199 INVESTIGATION OF THE SPIN DEPENDENCE IN THE DEUTERON-NUCLEUS INTERACTION. Knutson, L. D.; Haeberli, W. (University of Wisconsin, Madison, Wisconsin, 53706). Phys. Rev. Lett. 30: No. 20, 986-989 (14 May 1973).

Measurements of the cross section, the vector analyzing power, and the three tensor analyzing powers have been made for deuteron elastic scattering from ^{90}Zr at 5.5 MeV. The measurements are explained by an optical-model potential whose spin-dependent parts are calculated from the nucleon-nucleus potential. The predicted spin-orbit potential, which is considerably different from the potentials used in previous phenomenological analyses, also gives excellent agreement with the vector analyzing power at 9 MeV. (auth)

26200 STUDY OF THE CRYSTAL LATTICE EFFECTS IN THE ^{149}Sm(n,α)^{146}Nd REACTION USING THERMAL NEUTRONS. Mueller, D. W. College Station, TX; Texas A and M Univ. (1973). 86p. University Microfilms Order No. 73-21,687.

Thesis (Ph.D.).

The effects of chemical form and temperature on alpha decay rates of the excited states of ^{150}Sm produced from thermal neutron capture of 0.096 eV by ^{149}Sm were studied. Targets of enriched ^{149}Sm as samarium oxide, samarium iodide, and samarium metal were each irradiated at temperatures of 100, 200, and 300°C in a water-moderated reactor. High-resolution alpha spectra were obtained using an electrostatic particle guide to transport the alpha particles away from the reactor core to the detector. Ratios of the intensity of the $4^- \rightarrow 2^+$ alpha transition to the intensity of the $3^- \rightarrow 0^+$ alpha transition of ^{150}Sm to ^{146}Nd were determined for all permutations of temperature and target material. As the temperature was increased from 100 to 300°C, the intensity ratio increased approximately 2.2% due to Doppler broadening. A shift in the en-

ergy of the resonance feeding the $4^- \rightarrow 2^+$ transition caused by different binding energies of the oxide and metal targets resulted in a change in the ratio of approximately 1.9%. Experimental ratios were compared with ratios calculated using the effective temperature model proposed by Lamb, and agreed with experimental error. (Diss. Abstr. Int., B)

26201 DECAY ENERGIES OF GASEOUS FISSION PRODUCTS AND THEIR DAUGHTERS FOR A = 88 TO 93. Clifford, J. R.; Talbert, W. L. Jr.; Wohn, F. K.; Adams, J. P.; McConnell, J. R. (Ames Laboratory, U.S. Atomic Energy Commission and Department of Physics Iowa State University, Ames, Iowa 50010). Phys. Rev. C 7: No. 6, 2535-2545 (June 1973).

A systematic study of β-decay energies has been made for mass-separated activities of Kr gaseous fission products and their daughters at the tristan on-line separator facility at the Ames Laboratory research reactor. A well-type plastic scintillator was used in coincidence with a Ge(Li) γ detector to determine β-group end-point energies and deduce Q values. The following β-decay energies have been determined: ^{88}Kr, 2.93 $\pm$ 0.03 MeV; ^{88}Rb, 5.30 $\pm$ 0.06 MeV; ^{89}Kr, 4.93 $\pm$ 0.06 MeV; ^{90}Kr, 4.35 $\pm$ 0.05 MeV; ^{90}Rb, 6.32 $\pm$ 0.07 MeV; ^{91}Kr, 6.12 $\pm$ 0.07 MeV; ^{91}Rb, 5.68 $\pm$ 0.04 MeV; ^{92}Kr, 5.97 $\pm$ 0.08 MeV; ^{92}Rb, 7.58 $\pm$ 0.15 MeV; ^{92}Sr, 1.93 $\pm$ 0.03 MeV; ^{93}Kr, 8.3 $\pm$ 0.5 MeV; and ^{93}Rb, 7.23 $\pm$ 0.10 MeV. The decay energies are compared with previous measurements, systematics predictions, and two currently accepted mass relations. The energies are used to predict the β-decay energies for 13 additional nuclei by means of systematics. (auth)

26202 SPECTROSCOPIC INVESTIGATION OF EVEN-EVEN NEUTRON-DEFICIENT Gd ISOTOPES. Krien, K.; Djadali, F.; Naumann, R. A.; Hübel, H.; Spejewski, E. H. (Joseph Henry Laboratories of Physics and Frick Chemical Laboratory, Princeton University, Princeton, New Jersey 08540). Phys. Rev. C 7: No. 6, 2484-2499 (June 1973).

Properties of levels in ^{146}Gd, ^{148}Gd, and ^{150}Gd have been investigated both by observing the electron-capture decay of ^{148}Tb and ^{150}Tb as well as the γ transitions following the (α,xn) reactions on ^{144}Sm and ^{148}Sm targets. Decay schemes were constructed or confirmed. The angular distributions of the γ lines with respect to the beam direction enabled spin assignments for most states. Searches for isomerism revealed lifetimes of $T_{1/2}$ = 17.3 $\pm$ 2.0 nsec and $T_{1/2}$ = 9.1 $\pm$ 2.0 nsec, respectively, for the 8^+ 2689-kev level in ^{148}Gd and the 6^+2981-keV state in ^{146}Gd and indicate a particle character for these states. An upper limit of 5 nsec was derived for the half-lives of any level reached in ^{150}Gd. The decay schemes of ^{148}Gd and ^{150}Gd are similar to those of the neighboring neutron-deficient nuclei, e.g., ^{148}Sm and ^{146}Nd. The low-lying negative-parity states observed may represent a collective sequence based on a 3^+ state. (auth)

26203 HOW GOOD ARE THE THEORETICAL INTERNAL-CONVERSION COEFFICIENTS?. Raman, S.; Walkiewicz, T. A. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830); Gunnink, R.; Martin, B. Phys. Rev. C 7: No. 6, 2531-2535 (June 1973).

We have accurately measured the total-conversion coefficient for the 156.0-keV, M4 transition in ^{117}Sn as α_T = 46.40 $\pm$ 0.25. The Hager and Seltzer theoretical value is 47.8. A comparison between experimental and theoretical α_K and α_T values for 15 E3 and M4 transitions shows that the theoretical values are systematically 2-3% higher. (auth)

26204 MICROSCOPIC ^{130}Ba(n,γ) CROSS SECTION AND THE ORIGIN OF ^{131}Xe ON THE MOON. Berman, B. L.; Browne, J. C. (Lawrence Livermore Laboratory, University of California, Livermore, California 94550). Phys. Rev. C 7: No. 6, 2522-2531 (June 1973).

The ^{130}Ba(n, γ) cross section has been measured from 0.5 to 5000 eV with an energy resolution of 0.4%. The large epithermal resonances found in this experiment explain the anomalously high concentrations of ^{131}Xe found in lunar rocks, and the measured resonance parameters provide one with a quantitative tool for correlating burial depth with exposure age for lunar samples. (auth)

26205 SEARCH FOR AN EXCITED ROTATIONAL BAND IN ^{98}Mo WITH THE (p,t) REACTION. Sharma, H. L.; Seltz, R.; Hintz, N. M. (School of Physics and Astronomy, University of Minnesota, Minneapolis, Minnesota 55455). Phys. Rev. C 7: No. 6, 2567-2574 (June 1973).

The (p,t) reaction has been used to study the ^{98}Mo nucleus which is expected to show the characteristics of a shape-transitional nucleus. A search has been made for a rotational band built upon the 0^+ state at 737 keV. The incident energy was 19 MeV. Cross sections were measured to many states and a number of spins and parities were assigned from the (p,t) angular distribution. The results show no positive evidence for an axially symmetric rotational band built upon the 737 keV (0^+) state. The levels observed agree with those predicted from an axially asymmetric rotor in the model of Gneuss and Greiner. The present spin and parity assignments agree with the previous work for most of the states. However, a few discrepancies have been found. (auth)

26206 GAMMA DECAY OF LOW-LYING LEVELS IN ^{93}Nb. Tapphorn, R. M.; Shnidman, R. (United States Army Ballistic Research Laboratories, Aberdeen Proving Ground, Maryland 21005). Phys. Rev. C 7: No. 6, 2580-2589 (June 1973).

Mean lifetimes for four levels in ^{93}Nb have been measured by the Doppler-shift attenuation method. γ-ray angular distributions have been measured for the γ decay of excited levels in ^{93}Nb up to 1127 keV in excitation. The levels were excited by the ^{90}Zr(α, pγ)^{93}Nb reaction at a bombarding energy of 14.77 MeV. Spectra of γ rays in coincidence with protons were obtained with a 55-cm^3 Ge(Li) detector. Spin assignments obtained from the present results for the low-lying positive-parity levels in ^{93}Nb are in agreement with previous assignments. A J^π of $(3/2)^-$ has been assigned to a level at 685 keV in excitation and a J^π of $(5/2)^-$ $(3/2^-)$ has been assigned to an 809-keV negative-parity level. γ-ray mixing ratios measured for the γ decay of excited low-lying levels in ^{93}Nb have been combined with lifetime measurements to calculate the electromagnetic transition strengths. The experimental E2 transition strengths are shown to be consistent with those predicted by a weak-coupling model. (auth)

26207 E2 CORE POLARIZATION IN ^{92}Mo BY LIFETIME MEASUREMENT OF 6^+ STATE. Gil, C. (Tokyo Univ.). J. Phys. Soc. Jap.; 34: No. 3, 575-578(Mar 1973).

The lifetime of the 6^+ state in ^{92}Mo was measured by means of the gamma-gamma delayed coincidence method. The 330 keV ($6^+ \rightarrow 4^+$) gamma-ray from the 2613 keV level in ^{92}Mo was found to decay with a half-life $T_{\frac{1}{2}}$ = 1.51 $\pm$ 0.08 ns. An experimental value of B(E2: $6^+ \rightarrow 4^+$) was determined to be 76 $\pm$ 2e^{2}fm^4. Assuming four-particle configurations of $g_{\frac{9}{2}}$ and $p_{\frac{1}{2}}$ protons both for the 6^+ and 4^+ states a polarization charge for the $g_{\frac{9}{2}}$ proton is deduced to be 0.61e. (auth)

26208 RELAXATION AND DEORIENTATION OF ^{110}Ag($T_{\frac{1}{2}}$ = 24.4s) NUCLEI PRODUCED BY CAPTURE OF POLARIZED NEUTRONS IN THE SILVER HALIDES. Mertens, J. (Univ., Heidelberg); Ackermann, H.; Dubbers, D.; Heitjans, P.; Winnakker, A.; von Blanckenhagen, P. Z. Phys.; 262: No. 3, 189-210(1973).

Polarized ^{110}Ag nuclei are produced in the silver halides by capture of polarized neutrons at temperatures below 30 K and magnetic field strength up to 6 kOe. The depolarization process is studied by observation of the β-decay asymmetry as a function of magnetic field, temperature and radio frequency field strength in NMR signals. The depolarization is caused by a field-dependent deorientation process and by temperature-dependent spin-lattice relaxation. The deorientation is due to a succession of coupling steps of the nuclear spin with electromagnetic fields of defects generated as a consequence of the capture process, and the field dependence of the polarization can be understood as a decoupling curve. The temperature dependence of the spin-lattice relaxation is in accordance with the theory of quadrupole relaxation above 18 K if an empirical phonon spectrum is used for the calculation. At lower temperatures the experimental relaxation rate is anomalously high, which may be due to resonance modes connected with recoil lattice defects. (10 figures, 2 tables) (auth)

26209 NUCLEAR DATA SHEETS FOR A = 124. Bertrand, F. E. (Oak Ridge National Lab., TN). Nucl. Data, Sect. A; 10: No. 2, 91-150(Aug 1973).

The 1960 version of the Nuclear Data Sheets for A = 124 was revised, based on data received before May 1973. All literature containing experimental nuclear structure data pertaining to A = 124 was reviewed and evaluated; ~200 references were used. Eight nuclei, In, Sn, Sb, Te, I, Xe, Cs, and Ba, are assigned as members of the 124 mass chain. Of these, only for Sn, Sb, and Te are extensive level schemes available. This A-chain is organized in four distinct parts, which appear in the following order: drawings, summary sheets, data sheets (for some nuclei there are no data sheets and references. (auth)

Nuclear Properties and Reactions, 150 ≤ A ≤ 189

Refer also to abstracts 24575, 26160, 26161, 26187, 26202, 26220, 26224, 26232, and 26269.

26210 NUCLEAR LEVEL SCHEME OF ^{175}Yb AND INVESTIGATION OF THE LOW-ENERGY ^{197}Au(n,γ)^{198}Au SPECTRA. Breitig, H. D. Munich; Technische Univ. (1971). 87p. (In German). Thesis.

The measurement of the ^{174}Yb(n,γ)^{175}Yb spectrum yielded 239 gamma lines in the energy range between 1,500 and 26 keV, of which 129 could be incorporated into a level scheme. The measurement of the neutron capture spectrum of ^{197}Au yielded 500 lines in the energy range of 1,000 to 30 keV. Apart from allowing a more accurate description of the known levels in terms of en-

ergy, these measured results contribute to a better understanding of the decay schemes and lead to further suggestions as to new rotational bands. (17 figures, 29 tables) (GE)

26211 MEASUREMENT OF α-DECAY BRANCHING RATIOS FOR ^{150,151}Dy AND ^{149}Tb^{m}. Bingham, C. R.; O'Kain, D. U. (The University of Tennessee, Knoxville, Tennessee 37916); Toth, K. S.; Hahn, R. L. Phys. Rev. C 7: No. 6, 2575-2579 (June 1973).

With the use of the helium-gas-jet technique and a high-resolution Ge(Li) detector α-decay branching ratios were measured for ^{150}Dy, ^{151}Dy, and ^{149}Tb^{m}. Sources containing these activities were produced by bombarding ^{141}Pr with ^{14}N and ^{12}C ions. They were then assayed for both α-particle and x-ray radioactivity. The branching ratios deduced are as follows: 0.32 ± 0.05 for ^{150}Dy, 0.055 ± 0.008 for ^{151}Dy, and (2.0 ± 0.4) × 10^{-4} for ^{149}Tb^{m}. The ^{151}Dy and ^{149}Tb^{m} ratios were found to be in good agreement with previous measurements. While the ratio deduced for ^{150}Dy is almost midway in value between two earlier determinations, it appears to be in real disagreement with the more precise of the two previous measurements. Consequences of this discrepancy are discussed with respect to published cross-section data and α-decay reduced widths for 84-neutron even-even nuclei. In the course of the investigation the half-life of ^{149}Dy was determined to be 4.6 ± 0.4 min from x-ray decay-curve analyses and 5.1 ± 0.9 min from the initial growth period observed in the decay of the 4.1-h, ^{149}Tb 3.967-MeV α group. (auth)

26212 DOUBLET SPLITTING IN EVEN-A DEFORMED NUCLEI. Weller, F. (Argonne National Lab., (IL). Z. Phys.; 262: No. 5, 425-438(1973).

The doublet splittings between excited two-quasiparticle states with parallel and antiparallel angular-momentum coupling in some even-A deformed rare earth nuclei have been calculated and compared with the experimental values. The influence of the various exchange forces is investigated, and results with both finite-range and zero-range forces are presented. Qualitative agreement is obtained when finite-range forces are used; but the SDI results — especially the spin-dependent ones — are also satisfactory if the states of the doublets are sufficiently pure two-quasiparticle states. This condition seems to be fulfilled by the doublet states considered in ^{162}Dy, but not by those considered in the nuclei ^{168}Er and ^{172}Yb, for which the experimental level splittings are rather large (about 450 keV) and could not be reproduced at all. These discrepancies are discussed. (3 figures, 4 tables) (GE)

26213 PROTON–TUNGSTEN NUCLEAR COLLISIONS AT 200 GeV. Florian, J. R. (Univ. of Washington, Seattle); Kirkpatrick, L. D.; Lord, J. J.; Martin, J.; Gibbs, R. E.; Kotzer, P.; Piserchio, R. AIP (Amer. Inst. Phys.) Conf. Proc.; No. 12, 126-130(1973).

From conference on high energy particle interactions; Nashville, TN (26 Mar 1973).

Nuclear track emulsions loaded with tungsten granules were exposed to 200 GeV protons at the National Accelerator Laboratory. Proton-tungsten nuclear interactions were located by area scanning and angular measurements were conducted on the shower particles. The average multiplicity $\langle n_s \rangle$, was found to be 16.8 ± 1.5. The angular distribution was compared to that for proton–proton interactions and was found to be nearly the same for small angles, but considerably enhanced for large angles. Comparisons were made with intranuclear cascade models. (auth)

Nuclear Properties and Reactions, 190 ≤ A ≤ 219

Refer also to abstracts 26140, 26155, 26160, 26188, 26224, 26232, and 26256.

26214 (COO-3246-5) RESEARCH IN NUCLEAR CHEMISTRY. Progress Report. Kaplan, M. (Carnegie-Mellon Univ., Pittsburgh, Pa. Dept. of Chemistry). Jul 1973. Contract AT(11-1)-3246. 55p. Dep. NTIS $4.75.

The experimental nuclear chemistry research program encompasses studies of nuclear properties, nuclear transitions and decay, nuclear reactions, and the interactions of nuclear moments with the extranuclear environments in molecules, crystals, and amorphous materials. Moessbauer resonance experiments with ^{151}Eu nuclei in $Eu(NH_3)_6$ and with ^{57}Fe nuclei in $FeCl_3 \cdot 6H_2O$ and in frozen aqueous solutions have elucidated the magnetic hyperfine interactions in these substances and the behavior of the magnetization in external magnetic fields. Precision measurements of nuclear gamma–gamma angular correlations are providing definitive evidence for small admixtures of higher multipoles in several nuclear transitions in ^{207}Pb, and gamma-ray anisotropies from the decay of radioactive ^{206}Bi nuclei oriented in the hyperfine field of a Ni host have led to M1/E2 mixing ratio for six electromagnetic transitions in ^{206}Pb. (14 figures, 6 tables) (auth)

For title listing of selected papers see: 26215 and 26216.

26215 (COO-3246-5, pp 33-38) GAMMA-RAY MULTIPOLARITY STUDIES BY THE NUCLEAR ORIENTATION OF ^{206}Bi IN NICKEL. Jul 1973.
In Research in Nuclear Chemistry.

26216 (COO-3246-5, pp 39-49) ANGULAR CORRELATION OF NUCLEAR GAMMA RAYS AND DETERMINATION OF TRANSITION MULTIPOLARITIES IN ^{207}Pb. Jul 1973.
In Research in Nuclear Chemistry.

26217 (RLO-1388-221, pp 66-69) NEUTRON PICKUP USING THE ^{208}Pb(α, ^{5}He) REACTION. Brown, D. R.; Halpern, I.; Heffner, R. H.; Liu, K. L.; Russo, P. A. Jun 1973.
In annual report, 1973.

26218 (RLO-1388-221, pp 70-74) ELASTIC SCATTERING OF POLARIZED PROTONS FROM ^{208}Pb. Baker, M. P.; Blair, J. S.; Cramer, J. G.; Preikschat, E.; Weitkamp, W. G. Jun 1973.
In annual report, 1973.

26219 X-RAY EMISSION FOLLOWING NUCLEAR REACTIONS. Deconninck, G. (Facultés Universitaires, B-5000 Namur, Belgium); Longequeue, N. Phys. Rev. Lett. 30: No. 18, 863-866 (30 Apr 1973).

We have recorded and analyzed spectra of x-rays following proton and α-particle bombardment of heavy atoms. The normal K x rays are accompanied by satellite peaks originating from nuclear reactions. The phenomenon is very intense in α-induced reactions and it is correlated with (α,xn) cross sections; in the case of proton bombardment the intensity of the phenomenon is surprisingly weak. It is presumed that the ionization is due to internal conversion of residual γ rays. (auth)

26220 CROSS-SECTION MEASUREMENTS FOR THE (p,n) ANALOG TRANSITION IN ^{181}Ta, ^{197}Au, AND ^{209}Bi. Grimes, S. M.; Anderson, J. D.; Davis, J. C.; Dunlop, W. H.; Wong, C. (Lawrence Livermore Laboratory, Livermore, California, 94550). Phys. Rev. Lett. 30: No. 20, 992-995 (14 May 1973).

Cross sections for (p, n) transitions to analog states for targets of Ta, Au, and Bi have been measured. The cross section and decay width observed for Bi are inconsistent with those obtained from (p, nγ) measurements. We propose an explanation for these discrepancies. (auth)

26221 RADIATIVE CAPTURE OF 1s ELECTRONS IN ^{204}Tl. Lancman, H.; Bond, A. (Brooklyn College of the City University of New York, Brooklyn, New York 11210). Phys. Rev. C 7: No. 6, 2600-2602 (June 1973).

Previous measurements of the internal bremsstrahlung associated with the K-capture decay of ^{204}Tl have ignored the contribution to the spectrum due to double internal bremsstrahlung from the β decay of ^{204}Tl. We have measured the internal bremsstrahlung spectrum, using a two-parameter analysis to subtract this contribution. A fit to the data using the theory of Glauber and Martin and a relativistic correction factor R_u = 0.29 yields a transition energy of 385 ± 20 keV. The ratio of the theoretical to the experimental intensity is 3.6. (auth)

26222 COMMENTS ON THE DOORWAY STATE IN ^{206}Pb. Allen, B. J.; Macklin, R. L.; Fu, C. Y.; Winters, R. R. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). Phys. Rev. C 7: No. 6, 2598-2600 (June 1973).

The neutron capture cross section of ^{206}Pb(n, γ) has been measured with high resolution at the Oak Ridge electron linear accelerator. The capture results show that the reported $S_{(1/2)}$ doorway in ^{206}Pb is not observed in the photon channel. (auth)

26223 WEAK-COUPLING STRUCTURE IN ^{207}Bi STUDIED WITH THE ^{209}Bi(p,t)^{207}Bi AND ^{208}Pb(p,t)^{206}Pb REACTIONS. Erb, K. A.; Bhatia, T. S. (University of Pittsburgh, Pittsburgh, Pennsylvania 15213). Phys. Rev. C 7: No. 6, 2500-2509 (June 1973).

The ^{209}Bi(p,t)^{207}Bi and ^{208}Pb(p,t)^{206}Pb reactions were studied at a proton energy of 17.8 MeV in order to examine possible relationships between the nuclear structures of ^{207}Bi and ^{206}Pb. From a detailed comparison of the cross sections and angular distributions observed in the two reactions, it is concluded that a number of low-lying levels in ^{207}Bi are built upon core excitations which can be identified with the levels of ^{206}Pb. The cross-section comparisons served to measure the fragmentation of the observed core strengths caused by the particle-core interaction in ^{207}Bi, and yielded the corresponding weak-coupling wave-function amplitudes for the low-lying ^{207}Bi levels. The results show that considerable mixing occurs in ^{207}Bi between members of a multiplet based on the 2^{+}_{1} core excitation and the single-particle proton levels, so that the L = 2 ^{209}Bi(p,t)^{207}Bi cross section was not distributed according to the normal (2J + 1) rule. The measured

wave-function amplitudes are consistent with a weak-coupling structure, however, and also are consistent with $^{206}Pb(^{3}He,d)^{207}Bi$ measurements of the fragmentation of the single-particle proton strengths produced by the particle-core interaction. (auth)

Nuclear Properties and Reactions, A ≥ 220

Refer also to abstracts 25677, 26092, 26188, and 26244.

26224 (AEEW-M-1191) MINIGAL OUTPUT FROM UK NUCLEAR DATA LIBRARY: NDL1 (1973) THERMAL CROSS SECTIONS, RESONANCE INTEGRALS, AND FISSION SPECTRUM AVERAGES. Pope, A. L.; Story, J. S. (Atomic Energy Establishment, Winfrith (England)). Apr 1973. 19p. Dep. NTIS (U.S. Sales Only) $3.00.

A tabulation is given, calculated and printed by the programme MINIGAL from all neutron cross-section data files in the main tape (NDL1) of the March 1973 edition of the UK Nuclear Data Library, of: (i) Cross-section values for neutrons of 0.025298 eV; (ii) Thermal neutron cross-sections averaged over a Maxwellian neutron spectrum with kT = 0.025298 eV; (iii) Epithermal (resonance) integrals over a 1/E neutron flux distribution from 0.55 eV to 2 MeV; (iv) Fission spectrum averaged cross-sections, using the Watt-Cranberg form for the prompt fission neutron spectrum from thermal-neutron-induced fission of ^{235}U. (auth)

26225 (FEI-300) NEUTRON YIELD IN SPONTANEOUS FISSION OF EVEN-EVEN CURIUM ISOTOPES. Prokhorova, L. I.; Nesterov, V. G.; Smirenkin, G. N. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Obninsk. Fiziko-Energeticheskii Institut). 1971. 9p. (In Russian). INIS.

A measurement of the mean number of neutrons, $\bar{\nu}$, in the spontaneous fission process yielded, for ^{244}Cm, 2.700 ± 0.014; for ^{246}Cm, 2.934 ± 0.014, for ^{248}Cm, 3.157 ± 0.015. The dependence of $\bar{\nu}$ on the nucleon composition and excitation energy of the fissioning nucleus is discussed. (tr-auth)

26226 (JINR-P15-7119) MULTIPLICITY OF PROMPT NEUTRONS AT SPONTANEOUS FISSION OF NUCLEI. Dakovskii, M.; Lazarev, Yu. A.; Oganesyan, Yu. Ts. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1973. 24p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.25.

Distributions of a number of prompt neutrons P_ν, emitted from spontaneous fission of ^{244}Cm and ^{248}Cm, are measured. For ^{246}Cm an average number of neutrons per fission act is determined to be $\bar{\nu}$ = 2.98 ± 0.03 with respect to $\bar{\nu}$ = 2.69 ± 0.01 for ^{244}Cm. The review of experimental data on dispersion of a number of prompt fission neutrons σ_ν^2 is presented. The dependence of σ_ν^2 on Z, A and excitation energy of fissioning nucleus is analyzed. An assumption is made about the correlation between σ_ν^2 and the value of the fragment yield in the symmetrical mass region. (auth)

26227 (LA-UR-73-1178) FISSION BARRIERS FOR DOUBLY EVEN ACTINIDE NUCLEI FROM (t,pf), (^{3}He,df), (p,p'f), AND (t,αf) STUDIES. Back, B. B.; Hansen, O.; Britt, H. C.; Garrett, J. D. (Los Alamos Scientific Lab., N. Mex.). 1973. Contract W-7405-eng-36. 18p. (CONF-730823-17; SM-174/27). Dep. NTIS.

From 3rd symposium on physics and chemistry of fission; Rochester, New York, USA (13 Aug 1973).

Fission probability distributions have been measured for $^{230,232,234}Th$, $^{232,236,238,240}U$, $^{238,242,244}Pu$ and $^{244,248,250}Cm$ using (t,pf), (^{3}He,df), (p,p'f) and (t,αf) reactions. In general, resonance structures are observed in the fission probability distributions near threshold. The results are analyzed with a statistical model which incorporates resonant penetration through the two-peaked fission barrier and damping in the second well. From the analysis, estimates are obtained for the heights and curvatures of the two peaks of the fission barrier (E_A,$\hbar\omega_A$,E_B,$\hbar\omega_B$). The results give a value ~6 MeV for the height, E_A, of the first peak for most nuclei, whereas the height of the second peak, E_B, decreases from ~6 MeV to ~4 MeV in going from Th to Cm isotopes. A major exception to the apparent constancy of E_A occurs between N = 152 and N = 154, where for ^{248}Cm, E_A = 6.2 MeV, while for ^{250}Cm, E_A = 5.1 MeV. Comparison to ground-state mass systematics suggests that only about one-half of the change in E_A between ^{248}Cm and ^{250}Cm is due to the N = 152 shell at the equilibrium deformation. (5 figures, 1 table) (auth)

26228 (RLO-1388-221, pp 125-129) GAMMA BRANCH OF THE ^{238}U SHAPE ISOMER. Heffner, R. H.; Jacobs, W. W.; Pedersen, J.; Russo, P. A.; Vandenbosch, R. Jun 1973.

In annual report, 1973.

26229 (RLO-1388-221, pp 129-131) RELATIVE EXCITATIONS OF THE ^{237}Pu SHAPE ISOMERS. Methot, R. Jr.; Russo, P. A.; Sletten, G.; Vandenbosch, R. Jun 1973.

In annual report, 1973.

26230 NEW DATA ON THE α DECAY OF ^{249}Cf. Baranov, S. A.; Shatinskii, V. M.; Kulakov, V. M.; Rodionov, Yu. F. (Inst. of Atomic Energy, Moscow). Zh. Eksp. Teor. Fiz.; 64: No. 6, 1970-1974(Jun 1973). (In Russian).

The α spectrum of ^{249}Cf is investigated in the 5750 to 5140 keV α-particle range by means of a precision magnetic α-spectrometer with spatial particle beam focussing at an angle $\pi\sqrt{2}$. Twenty-three α transitions to ^{245}Cm levels in the 0.5 to 1.0 MeV excitation energy range are observed. The γ rays are studied with a Ge(Li) detector with a volume of ~5 cm^3. It is possible to set up a more complete energy level scheme for ^{245}Cm on basis of an analysis of the experimental data. In particular, rotational bands $7/2^-[743]$ and $7/2^+[613]$ ascribable to the 645 and 722 keV levels are observed. It is pointed out that a rotational band $3/2^+[622]$ for an excitation energy ~900 keV may exist. (auth)

26231 ASYMPTOTIC ELECTRON TERMS OF COLLIDING IDENTICAL HEAVY NUCLEI. Krainov, V. P.; Zakharov, S. I. (Moscow Engineering-Physics Inst.). Zh. Eksp. Teor. Fiz.; 64: No. 6, 1950-1957(Jun 1973). (In Russian).

Variation of the energy levels of the inner shells of heavy nuclei bombarded by identical nuclei (e.g., uranium-uranium collisions) is investigated in the adiabatic approximation. The problem is considered in the asymptotic limit when the distance between the nuclei is great compared to the electron Compton wavelength. A formula is derived for the dependence of the electron term energy on nuclear charge and distance between the nuclei. A quasiclassical formula for excited states with a large number of nodes is obtained which yields the splitting of levels of two identical three-dimensional wells separated by a high barrier. The pre-exponential factor in the quasiclassical problem of level splitting of two identical one-dimensional wells separated by a high barrier is discussed. (auth)

26232 NUCLEAR INERTIAL MASS PARAMETER B IN THE ADIABATIC APPROXIMATION. Stepien-Rudzka, W. (Inst. of Nuclear Research, Warsaw). Acta Phys. Pol.; B4: No. 4, 467-487(1973).

The nuclear inertial mass parameter B is investigated by means of two slightly different approaches, both making use of the adiabatic approximation for the collective motion. The numerical results are given for two regions: the superheavy nuclei $108 \leq Z \leq 124$, $172 Z \leq N \leq 188$ and the neutron-rich nuclei $88 \leq Z \leq 104$, $172 \leq N \leq 194$. The influence of the choice of the Nilsson model parameters κ and μ is investigated together with the dependence on the deformation parameters ϵ and ϵ_4. (auth)

26233 SYMMETRIC AND ASYMMETRIC FISSION OF Ac-ISOTOPES NEAR THE FISSION THRESHOLD. Konecny, E. (Technische Univ., Munich); Specht, H. J.; Weber, J. (1973). vp.

From spring meeting of the Deutsche Physikalische Gesellschaft, Part A: nuclear physics; Heidelberg, Germany (19 Feb 1973).

Fission probabilities and fragment anisotropies were investigated for fission of ^{227}Ac and ^{228}Ac using direct reactions with a ^{3}He beam on a ^{226}Ra target. Triple-humped mass distributions are found also for excitation energies where second-chance fission is excluded. The fission barrier is higher for symmetric fission compared to that for asymmetric fission by 1.2 and 2 MeV, respectively, suggesting that the character of the mass split is already predetermined at the saddle point. (2 figures) (auth)

26234 IDENTIFICATION OF THORIUM-236. Kaffrell, N.; Trautmann, N. (Univ., Mainz). Z. Naturforsch.; 28A: No. 3-4, 541(1973).

The new nuclide ^{236}Th has been produced via the (γ,2p) reaction by irradiation of ^{238}U with 140 MeV bremsstrahlung. After chemical separation of thorium, the half-life was determined to be 36 ± 3 min from the growth-decay curve of the strongest γ-ray transition of the daughter nuclide, 9-min ^{236}Pa. (1 figure) (auth)

26235 PRECISION MEASUREMENT OF GAMMA RAY ENERGIES FROM ^{238}U DAUGHTERS. II. Sampson, T. E. (Los Alamos Scientific Lab., NM). Nucl. Instrum. Methods; 111: No. 2, 209-211(1973).

Precision measurement of the gamma-ray energies of the three most prominent gamma rays occurring in the β^- decay of the ^{234}Th daughter of ^{238}U are reported. The relative intensities of the components of the 92.5-keV doublet are also presented. (2 figures, 2 tables) (auth)

26236 ABSOLUTE SPECIFIC ACTIVITY AND HALF LIFE FOR ^{249}Cf. Stokely, J. R.; Bemis, C. E. Jr.; Baybarz, R. D.; Eby, R. (Oak Ridge National Lab., TN). J. Inorg. Nucl. Chem.; 35: No. 9, 3369-3371(Sep 1973).

A method previously developed for the absolute chemical determination of curium (McCracken et al., J. Inorg. Nucl. Chem.; 33: 3251 (1971)) has been applied to the determination of the absolute specific activity and half-life for ^{249}Cf. The absolute microchemical determination of Cf was accomplished using a complexometric titration with EDTA. Excess EDTA added to the solution was determined by coulometric titration with mercury(II). The results of replicate chemical determinations coupled with mass spectrometric and alpha spectrum analyses, together with absolute alpha counting, have yielded a half-life of 350.6 ± 2.1 yr, corresponding to an absolute specific activity of $(9.093 \pm 0.055) \times 10^6$ dpm/μg. (UK)

26237 SIGN OF THE HEXADECAPOLE MOMENTS OF ^{232}TH AND ^{238}U NUCLEI. Eichler, E.; Johnson, N. R.; Sayer, R. O.; Hensley, D. C.; Riedinger, L. L. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). Phys. Rev. Lett. 30: No. 12, 568-571 (19 Mar 1973).

The ambiguity in the sign of the hexadecapole moments of ^{232}Th and ^{238}U, as determined from α-particle Coulomb-excitation experiments, has been resolved by experiments using 145-MeV ^{40}Ar to multiply Coulomb excite these nuclei up to their 12^+ states. Excellent agreement with the experimental results was obtained with predictions from the Winther-de Boer program when positive M(E4) values were used, while significant disagreement was found when the negative M(E4) values were used. (auth)

26238 MULTIPOLE DEFORMATION OF ^{238}U. Hendrie, D. L.; Harvey, B. G.; Meriwether, J. R.; Mahoney, J.; Faivre, J.; (and others) (Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). Phys. Rev. Lett. 30: No. 12, 571-573 (19 Mar 1973).

Elastic and inelastic scattering of 50-MeV helium ions from ^{238}U was studied with a high-resolution magnetic spectrometer. We measured angular distributions for members of the ground-state rotational band up to the 8^+ level. Coupled-channels calculations yield 0.022, 0.060, and -0.012 for the respective deformation parameters β_2, β_4, and β_6 for an optical radius of $1.44A^{1/3}$fm. These values are compared with other experimental results. (auth)

26239 PRODUCTION OF 62-SEC ^{222m}Ac. Molzahn, D.; Brandt, R. (Kernchemie, F.B.14, Philipps-Universität, 355 Marburg, Germany). Phys. Rev. C 7: No. 6, 2596-2597 (June 1973).

The existence of a 62 ± 5-sec isomer of ^{222}Ac is confirmed. Its production cross section in thorium bombarded with 600-MeV protons is 8.8 ± 1.4 mb. (auth)

26240 NUCLEAR SPECTROSCOPY STUDIES ON THE ALPHA DECAY OF ^{235}Np AND BETA DECAY OF ^{231}Th. Browne, E.; Asaro, F. (Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). Phys. Rev. C 7: No. 6, 2545-2566 (June 1973).

The α decay of ^{235}Np has been studied by quantitative α singles and α-γ coincidence techniques, and the β decay of ^{231}Th by quantitative γ-ray singles and γ-γ two-parameter coincidence measurements with semiconductor detectors. Rotational bandheads in ^{231}Pa at 102.30, 174.10, and 183.47 keV are given the Nilsson assignments $[\Omega\pi (Nn_zA)](3/2)^+(651)$, $(5/2)^-(523)$, and $(5/2)^+(642)$. Decay schemes for ^{235}Np and ^{231}Th are presented as well as a transition intensity balance for ^{231}Th which includes β branchings. Energy level spacings and α, β, and γ transition probabilities are interpreted in terms of a strong Coriolis interaction among the even-parity rotational bands and admixtures in the wave functions are given for the observed levels. (auth)

26241 SYSTEMATICS OF FRAGMENT MASS AND ENERGY DISTRIBUTIONS FOR PROTON-INDUCED FISSION OF ^{233}U, ^{235}U, AND ^{238}U. Ferguson, R. L.; Plasil, F.; Pleasonton, F.; Burnett, S. C.; Schmitt, H. W. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). Phys. Rev. C 7: No. 6, 2510-2522 (June 1973).

Thin targets of ^{233}U, ^{235}U, and ^{238}U were bombarded with protons of several energies between 7 and 13 MeV. Correlated energies of fission-fragment pairs were measured with silicon surface-barrier detectors. Fragment mass vs total kinetic energy distributions were deduced and their systematic variation with bombarding energy was studied. It was found that the yield in the valley of the mass distributions for symmetric divisions increases with increasing excitation energy, and that the peaks move slightly toward symmetry. The average total kinetic energy for mass divisions with one fragment mass $\simeq$ 132 amu was found to decrease with increasing excitation energy, while for other mass divisions little change was observed. The average over-all total kinetic energy was found to decrease with increasing bombarding energy, and widths of both the kinetic energy distributions and the mass distributions were found to increase somewhat. The results are discussed in terms of fragment shell effects which appear to persist to our highest excitation energy (~18 MeV), and also in terms of the two-component fission hypothesis. (auth)

Nuclear Theory

Refer also to abstracts 25391, 25803, 25963, 25978, 26103, 26140, and 26219.

26242 (CONF-730815-2) DIRECT REACTIONS WITH LIGHT IONS. Satchler, G. R. (Oak Ridge National Lab., Tenn.). 1973. 33p. Dep. NTIS $3.75.

From international conference on nuclear physics; Munich, F. R. Germany (27 Aug 1973).

Recent attempts to go beyond the DWBA in analysis of nuclear reactions, such as the coupled-channels method, are discussed first. The importance of inelastic and pick-up/stripping effects is illustrated. Some special problems arise because the deuteron is weakly bound; an attempt to overcome these, the adiabatic model of deuteron stripping, is set forth. Analysis of work with polarized beams, particularly vector- and tensor-polarized deuterons, is then examined. Two recent attempts to improve the usefulness of the phenomenological optical model through the Lane model are reviewed. In contrast, the "microscopic" treatment of scattering is also discussed. In conclusion, the use of sum rules in the analysis of spectroscopic factors from transfer reactions is recalled. (21 figures, 68 references) (RWR)

26243 (CONF-730923-1) CALCULATIONS OF THE IMAGINARY PART OF THE OPTICAL POTENTIAL. Satchler, G. R. (Oak Ridge National Lab., Tenn.). 1973. 13p. Dep. NTIS $3.00.

Semi-phenomenological calculations on the contributions to the imaginary part of the optical potential for protons, deuterons, and alpha particles from open inelastic and pick-up or stripping channels are discussed. The Feshbach formalism is chosen to express the optical potential, and this formalism is briefly reviewed. The important intermediate states and the interaction involved are treated. Then the results of calculations for 30-MeV protons on ^{40}Ca and ^{208}Pb are given; both inelastic excitations and pick-up terms are included in the discussion. Some preliminary work on alpha scattering is also described. It is concluded that it is easy to reproduce a measured absorption cross section with the conventional, local, optical potential, but this is not a good indicator of the validity of the calculation. Differential cross sections and partial wave amplitudes are generally in poor agreement with experiment. Some of the approximations in the calculations and resulting inadequacies are indicated. (6 figures) (RWR)

26244 (INDC(SEC)-31-U, pp 77-91) VALIDITY OF THE TEMPERATURE LAW FOR SPECTRUM OF INELASTIC SCATTERED NEUTRONS. L'Heriteau, J. P.; Ribon, P. (CEN, Saclay, France). Jan 1973.

In topical discussion on inelastic scattering of fast neutrons.

The energy distribution of inelastically scattered neutrons is usually described by a temperature law. This law is valid only in the continuum, and cannot be used to describe the spectrum of secondary neutrons when only a few levels are involved; there should, however, be a continuity between the resolved-level energy range and the continuum. The approximations which the law fulfills are discussed, and then the continuity between the two energy regions is examined for the case of ^{238}U. A lack of continuity is found. The discrepancy is connected with the approximation of the temperature law and the lack of knowledge of the nuclear level density between 1 and 3 MeV. (4 figures, 1 table) (RWR)

26245 (ITEF-935) HIGHER HARMONICS FOR ^{16}O NUCLEUS. Simonov, Yu. A.; Sadovoi, A. A. (Gosudarstvennyi Komitet po Ispol'Zovaniyu Atomnoi Energii SSSR, Moscow. Institut Teoreticheskoi I Eksperimental'Noi Fiziki). 1972. 20p. (In Russian). INIS.

There is proposed a simple and, at the same time, universal method for the construction of higher harmonics, the method of hyperspherical functions, having definite values of total orbital momentum, spin, isospin, and their projections. The method of calculation of normalization factors, overlap integrals, and two-particle matrix elements used has clear representation and simplicity. All harmonics $K_{min} + 2$ with $J^\pi = 0^+$, $T = 0$ are constructed for the nucleus ^{16}O. (tr-auth)

26246 (JINR-P7-7201) ANGULAR DISTRIBUTION OF PROMPT GAMMA RAYS IN HEAVY-ION-INDUCED REACTIONS. Balanda, A.; Krulyas, K. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1973. 12p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

A fast method of determining the angular distributions of the E2-type gamma transitions resulting from heavy-ion-induced reactions is described taking into account the Yamazaki formalism and phenomenological analysis. (auth)

26247 ELECTRON CAPTURE RATIOS IN ALLOWED TRANSITIONS. Beta Decay. Genz, H. (Univ., Bochum, Ger.); Fink, R. W.; Renier, J. P.; Siberts, J. B.; Ledingham, K. W. D.; Pengra, J. G. (1973). vp.

From spring meeting of the Deutsche Physikalische Gesellschaft, Part A: nuclear physics; Heidelberg, Germany (19 Feb 1973).

Existing experimental L/K capture ratios and various theoretical calculations are compared and discussed, special attention being paid to the measurement of the M/L orbital electron capture ratios that have been reported recently. It is seen from the comparison that only precision measurements of allowed M/L orbital electron capture ratios at low Z (Z < 36) will show which of the various current sets of electron wave functions and which of the various approaches in calculating the electron exchange-atomic overlap correction factors agrees best with the experiments. In the decay of ^{37}Ar, ^{55}Fe and ^{71}Ge the experimental M/L capture ratios agree within the error limits with theoretical predictions using the wave functions and the exchange corrections. (7 figures, 1 table) (GE)

26248 BOUND-STATE ENERGY OF A THREE-BOSON SYSTEM. Avalos, D. R. (Universidad Nacional, La Plata); Epele, L. N.; Gregorio, M. A. Lett. Nuovo Cim.; 8: No. 1, 6-10(1 Sep 1973).

The results of some calculations made with Faddeev equations for the study of the J = 0 bound-state energy spectrum of the system formed by three structureless alpha particles are reported. The system is compared with the low lying J = 0 states of carbon-12. The main concern is with the comparison of the different descriptions of the low energy properties of the 3α system as obtained with different nuclear potentials. The two-body parameters and bound-state energies for the J = 0 state of the 3α system are given. (JFP)

26249 SUPPRESSION EFFECT OF INELASTIC CHANNELS OF NUCLEAR REACTION IN CRYSTAL UNDER CONDITION OF HYPERFINE SPLITTING. Afanas'ev, A. M.; Kagan, Yu. (Inst. of Atomic Energy, Moscow). Zh. Eksp. Teor. Fiz.; 64: No. 6, 1958-1969(Jun 1973). (In Russian).

The dynamical theory of γ-quanta diffraction by resonant nuclei in crystal is developed under condition of hyperfine splitting. A wide variety of cases is predicted when the complete suppression of inelastic channels takes place. The obtained results permit one to find the optimal conditions for the observation of suppression effect practically only from knowledge of the hyperfine structure of the usual resonant absorption spectrum. As an example the case of the quadrupole splitting is considered in detail. (auth)

26250 ELECTRIC-QUADRUPOLE CONTRIBUTION TO THE DEUTERON PHOTOEFFECT. Bhatt, S. C.; Levinger, J. S. (Rensselaer Polytechnic Inst., Troy, NY). Lett. Nuovo Cim.; 8: No. 1, 33-36(1 Sep 1973).

The sum rule technique was used to obtain a differential cross section for the E2 multipole for the deuteron photoeffect. (JFP)

26251 MODELS FOR PROPAGATION OF COHERENTLY PRODUCED SYSTEMS THROUGH NUCLEI. Bialas, A. (Jagellonian Univ., Krakow); Zalewski, K. Acta Phys. Pol.; B4: No. 4, 533-544(1973).

The general properties of models where the absorption of systems coherently produced in nuclei are small, because the absorption parameters are replaced by a nondiagonal absorption matrix are investigated. A new class of such models in which the absorption from large diagonal terms of the absorption matrix is partly cancelled by the off-diagonal terms is discussed. The dependence of the mass distribution of the coherently produced system on nuclear radius in this class of models is different from that predicted by Van Hove model. For certain values of parameters the model discussed gives the mass distribution and absorption parameter independent of the nuclear radius, in apparent agreement with the data. (auth)

26252 EXPANSION OF NUCLEAR ROTATIONAL ENERGY IN POWERS OF ANGULAR VELOCITY OF ROTATION. Abrosimov, V. (Univ., Warsaw); Krumlinde, J.; Szymanski, Z. Acta Phys. Pol.; B4: No. 4, 437-447(1973).

The coefficients α, β, γ and δ appearing in the expansion of the nuclear rotational energy in powers of the square of angular velocity are calculated by a microscopic method. Two simplified nuclear two level models are used: with use of the BCS approximation, and based on the exact diagonalization of the nuclear rotational Hamiltonian including the short-range pairing forces acting between the nucleons. (auth)

26253 VARIATIONAL APPROACH TO JASTROW CORRELATIONS IN NUCLEI. Reinhard, P. G. (Erlangen-Nuernberg Univ., Erlangen, Ger.); Arenhoevel, H. Z. Phys.; 262: No. 1, 1-13(1973).

The variational equation determining the Jastrow correlation function is investigated with particular emphasis on the healing problem for both nuclear matter and finite nuclei. The consequences of several healing conditions are discussed. Furthermore, influences from the choice of the single-particle basis and from long-range correlations are studied, and are found to be small in the short-range region. (2 figures) (auth)

26254 LIMITATIONS ON SHORT-DISTANCE BEHAVIOR: REPULSIVE CORE. van der Merwe, P. D. T. (Atomic Energy Board, Pretoria). Lett. Nuovo Cim.; 7: No. 16, 806-808(18 Aug 1973).

A new approach to the problem of stability of matter is explored, which derives from limitations on the light-core behavior of the product of quantum fields. A novel feature of the approach is the natural emergence of a repulsive core, which suggests a unified view of particle interactions. (LBS)

26255 QUANTUM-MECHANICAL MOMENTUM FLUCTUATION IN THE THEORY OF NONLOCAL NUCLEAR FORCES. Lilja, I. A. (Research Inst. for Theoretical Physics, Helsinki); Haemaelaeinen, R. M. K. Nuovo Cim., 17A: No. 1, 55-65(1 Sep 1973).

The effect of nonlocality of the interaction potential of the nucleon system on the probability current density and through it on the momentum was studied. It appears that the use of the concept of momentum fluctuation facilitates considerably the calculations concerning the photonuclear reactions with the aid of sum rule techniques. In particular, this method makes it possible to consider explicitly the sums weighted by the negative power of the energy difference between the initial and the final states. The electric-dipole transitions were considered in detail. (auth)

26256 CALCULATION OF THE NUCLEAR BREATHING MODES. Jakubassa, D. H. (Technische Univ., Munich). Z. Phys.; 261: No. 4, 305-311(1973).

The collective compressional vibrations are described within the hydrodynamical model and the microscopic theory. We present calculations of the excitation energy, width and transition probability of the T = 0 and T = 1 breathing modes for the spherical nuclei ^{16}O, ^{40}Ca, ^{90}Zr, ^{120}Sn and ^{208}Pb. (1 figure, 4 tables) (auth)

26257 RESONANCE INTEGRAL WITH INTERFERENCE SCATTERING. Jawas, G. (Democritus Nuclear Research Center, Athens). Atomkernenergie; 21: No. 4, 290-292(1973).

For the calculation of the resonance integral when the interference scattering is taken into consideration, we come across two cases as far as the functions $\Psi(x, \Theta)$ and $X(x, \Theta)$ are concerned. The first case corresponds to the asymptotic expressions of these functions (Gauss Functions); and the second case, to that of the series expansions of ascending powers of Θ and descending powers of $1/(1 - x^2)$. (2 figures)(auth)

26258 EFFECT OF GROUND STATE CORRELATIONS ON THE IMAGINARY PART OF THE OPTICAL-MODEL POTENTIAL. Cugnon, J. (Univ., Liege). Z. Phys.; 261: No. 4, 359-370(1973).

The effect of the ground state correlations on the imaginary part of the nucleon–nucleus optical-model potential is qualitatively discussed within the random phase approximation (RPA). We also investigate the effect of terms of order higher than two in the microscopic nucleon–nucleus interaction. A rough estimate of both effects is given for the case ^{39}K + p. (1 figure, 1 table) (auth)

26259 SOLVABLE MODEL OF STRIPPING REACTIONS WITH VARIABLE SPECTROSCOPIC FACTOR. King, K. (Department of Theoretical Physics, University of Sydney, Sydney, New South Wales, Australia 2006); McKellar, B. H. J. Phys. Rev. Lett. 30: No. 12, 562-564 (19 Mar 1973).

Model three-body calculations have been performed with two-channel separable interactions to test the predictions for angular distributions and spectroscopic factors by Butler, Hewitt, McKellar, and May, and distorted-wave-approximation theories of deuteron stripping. There are indications that both theories are inadequate. (auth)

26260 EXPERIMENTAL EVIDENCE CONCERNING THE ISOSPIN DEPENDENCE OF THE EFFECTIVE NUCLEON-Δ_{33} FORCE. Danos, M. (National Bureau of Standards, Washington, DC). Lett. Nuovo Cim.; 7: No. 16, 819-820(18 Aug 1973).

Experimental evidence was previously found for a wide peak lying in the vicinity of the Δ_{33} energy from the bombardment of ^4He by 300- to 500-MeV photons. The data show that the nucleon–Δ system forms a deuteronlike T = 2 bound state with a binding

energy of ~40 MeV, while the same system in the T = 1 state is unbound. It is suggested that the experimental absence of the resonance in the T = 1 system is a consequence of the isospin-dependent term in the nucleon–Δ effective force. (LBS)

26261 ALGEBRAIC APPROACH TO THE THEORY OF COLLECTIVE MOTION: SPHERICAL TO DEFORMED TRANSITION IN THE SINGLE-J SHELL. Vallieres, M.; Klein, A. (Department of Physics, University of Pennsylvania, Philadelphia, Pennsylvania 19104); Dreizler, R. M. Phys. Rev. C 7: No. 6, 2188-2204 (June 1973).

The program of the algebraic approach to nuclear collective motion is summarized. In essence, it should permit an accurate solution of the many–body problem within a subspace of the many–particle space if the conditions defining collective motion are present. The formulation, containing both dynamical and kinematical aspects, leads to coupled nonlinear algebraic equations for the matrix elements between collective states of fermion pair operators. An explicit set of equations is given for the problem of N (even) particles confined to a single–j shell and described by the conventional pairing plus quadrupole–quadrupole interaction Hamiltonian. This formulation is designed to be nearly exact in the pairing–dominant (seniority) limit and to be accurate enough (based on plausibility arguments) to describe the transition from spherical to deformed shape. That this is so is verified for configurations, the largest being $j^N = (21/2)^6$, for which exact solutions are available. The present method can be viewed as an angular momentum conserving alternative to the description of the transition based on the Hartree–Bogoliubov–BCS method. Qualitative and detailed comparisons of the two methods are carried out. In particular, it is shown from approximate analytic results that the two theories predict the transition to occur for almost identical values of the parameters. Over-all agreement with exact results is much better for the algebraic method, however, confirming its status as an approximate method of variation after projection. (auth)

26262 SPIN–ORBIT – BOUND NUCLEI. Calogero, F. (Istituto di Fisica, Universitá di Roma, 00185 Rome, Italy); Palumbo, F. Phys. Rev. C 7: No. 6, 2219-2228 (June 1973).

It has been noted recently that a local spin–orbit nucleon–nucleon interaction, if taken seriously in the framework of nonrelativistic quantum mechanics, is generally inconsistent with the asymptotic saturation property of nuclear binding energies. This has motivated the conjecture that nuclear aggregates bound essentially by the spin–orbit interaction exist. The present paper constitutes an attempt to subject this conjecture to scrutiny, to the extent possible without abandoning the firm ground of well–understood, and mathematically sound, many–nucleon nonrelativistic theory, with "realistic" interactions mediated by potentials. (auth)

26263 SUM RULES, RANDOM–PHASE–APPROXIMATION, AND CONSTRAINED SELF–CONSISTENT FIELDS. Marshalek, E. R. (Department of Physics, University of Notre Dame, Notre Dame, Indiana 46556); João da Providência. Phys. Rev. C 7: No. 6, 2281-2293 (June 1973).

It is shown that the energy–weighted and inversely–energy–weighted (IEW) random–phase–approximation sum rules may be obtained simultaneously by a doubly constrained self–consistent field calculation. Applications of the IEW sum rule are made to the quadrupole–force Hamiltonian, including a case when zero–frequency modes occur. The relevance to certain higher–order sum rules is noted and discrepancies in some calculations of centrifugal stretching effects in spherical and deformed nuclei are pointed out. (auth)

26264 PION–NUCLEUS SCATTERING IN THE (3,3) RESONANCE REGION*. Dover, C. B. (Physics Department, Brookhaven National Laboratory, Upton, New York 11973); Lemmer, R. H. Phys. Rev. C 7: No. 6, 2312-2339 (June 1973).

A many–body formulation of pion–nucleus scattering in the (3,3) resonance region is presented. It is shown that the self–energy (optical potential) of a pion propagating through a Fermi gas of nucleon can be expressed as an integral over density of an effective pion–nucleons forward–scattering amplitude f(kq; kq) in the medium. Using a pseudoscalar pion–nucleon interaction, one finds that f(kq; kq) satisfies a modified form of the standard Chew–Low equation for pion–nucleon scattering. The effect of the medium is twofold: (i) The effective pion–nucleon coupling constant is quenched in the medium, and (ii) the pion–nucleon threshold of the effective amplitude is moved upwards in energy. Both effects are due to Pauli–principle restrictions on nucleons in intermediate states. Like its free–space counterpart, f(kq; kq) displays a resonance behavior in the (3,3) pion–nucleon channel. The resonance appears as a characteristic energy dependence in the pion–nucleus optical potential calculated from f(kq; kq). The resonance position in pion–nucleus scattering is determined by three competing effects, and generally differs from the free pion–nucleon (3,3) resonance energy. One finds that: (i) The quenching effect moves (3,3) resonance up in energy and narrows its width, (ii) the dispersive effect of the nuclear medium (increase of the real part of the wave number over the free–space value) moves the resonance downward, (iii) the energy dependence of the effective radius $R + \lambda$ seen by a pion of wavelength λ also shifts the resonance downward in energy. The net energy shift is thus a result of a rather delicate cancellation of several competing effects. Absorption cross sections for negative pions are calculated for a range of nuclei. In general, the net downward energy shift with respect to the free (3,3) resonance is found to increase with increasing mass number. (auth)

26265 OFF–SHELL EFFECTS IN NUCLEON–NUCLEUS SCATTERING. Sheerbaum, R. R.; Shakin, C. M.; Thaler, R. M. (Department of Physics, Case Western Reserve University, Cleveland, Ohio 44106). Phys. Rev. C 7: No. 6, 2346-2354 (June 1973).

It is shown that the usual multiple–scattering treatment of nucleon–nucleus elastic scattering does not provide a complete description of the process. In particular, the replacement of the two–nucleon interaction potential by a two–body T matrix (evaluated at a single parametric energy) leads to an inadequate treatment of the off–shell aspects of the multiple–scattering problem. As an example, we discuss the manner in which short–range correlations in the nuclear targets affect the off–shell behavior of the two–body scattering operators used to describe nucleon–nucleus scattering. The influence of these off–shell effects on the calculation of total cross sections is discussed. (auth)

26266 GENERATOR COORDINATE METHOD FOR SCATTERING: AN EXACT SOLUTION. Giraud, B.; Hocquenghem, J. C.; Lumbroso, A. (Service de Physique Théorique, Centre d'Etudes Nucléaires de Saclay B. P. n°2 – 91, Gif–sur–Yvette, France). Phys. Rev. C 7: No. 6, 2274-2281 (June 1973).

An analytically soluble model is given for which an exact numerical solution of the Hill–Wheeler equation in the continuum can be calculated. Properties of this model, which concern in particular the effects of the Pauli principle and the microscopic definition of an optical potential, are considered. (auth)

26267 OPTICAL POTENTIAL FOR SCATTERING FROM A SYSTEM OF FINITE–MASS PARTICLES. Walker, G. E. (Department of Physics, Indiana University, Bloomington, Indiana 47401). Phys. Rev. C 7: No. 6, 2256-2273 (June 1973).

We consider a projectile scattering elastically from a system of finite–mass constituents via a separable microscopic interaction. In order to reduce the situation to a solvable problem, several standard assumptions are necessary. The validity of these assumptions can be checked in a given model problem. The optical potential is identified by comparing the multiple scattering series we obtain with that obtained in the equivalent one–body problem. The optical potential explicitly exhibits the effects of the Fermi motion and finite mass of the target particles and is a generalization of an optical potential obtained earlier. Our results are in a form suitable for application to intermediate energy projectile many–body target scattering. (auth)

26268 COMPENSATION PROPERTIES OF THE TRANSITION AMPLITUDES FOR ELECTRIC NUCLEAR TRANSITIONS IN INELASTIC ELECTRON SCATTERING. Andresen, H. G. (Univ., Mainz). (1973). vp. (In German).

From spring meeting of the Deutsche Physikalische Gesellschaft, Part A.: nuclear physics, Heidelberg, Germany (19 Feb 1973).

The interpretation of the electron scattering data in the analysis of nuclear structure (e.g., charge distribution, nuclear currents) is not completely valid, as the nuclear parameters are dependent on theoretical models. The mathematical application of the "distorted wave Born approximation" (DWBA) and the complex formulation of the DWBA concerning the correlation between the distributions of nuclear charges and experimental effective cross sections are discussed. Phenomenological possibilities for using parameters are presented, kinds of gauging (Lorentz–gauging) and their influence on analytic forms of mathematical terms are described. Some of the three amplitudes are split into several terms by vector–analytic transformation, some compensate each other exactly ("compensation property of the transition amplitudes"); the most suitable for the computer for numerical formulation of electron scattering is derived. (GE)

26269 EXTENSION OF THE VARIABLE–MOMENT–OF–INERTIA MODEL TO HIGH SPINS. Das, T. K.; Banerjee, B. (Physik–Department, Technische Universita;ut München, 8046 Garching, Germany). Phys. Rev. C 7: No. 6, 2590-2592 (June 1973).

The variable–moment–of–inertia model of Mariscotti et al. is extended to high spins. (auth)

26270 ASYMMETRIC SHAPE OF NUCLEI AND THE VARIABLE MOMENT–OF–INERTIA MODEL. Gupta, R. K. (Research Institute for Physics, 10405 Stockholm, Sweden). Phys. Rev. C 7: No. 6, 2476-2483 (June 1973).

The variable moment–of–inertia (VMI) model for asymmetric

shape of nuclei which allows simultaneous analysis of data for both ground-state band and γ-vibrational band in even-even nuclei is worked out. For the asymmetric rotor we use Krutov's model which is based on the assumption of rotational flow and a rotationally invariant core in nuclei and predicts a linear dependence of the moment of inertia on the deformation—a condition used by the VMI model. The calculations (using a least-squares fitting procedure) are carried out for all the even-even nuclei which have at least two states above the ground state and two states above the γ-vibrational band head well established. The overall comparison with the experimental data is very good. The fits to the ground-state band, however, remain essentially the same as for the VMI model. (auth)

26271 CASCADE EMISSION OF γ-QUANTA BY HIGHLY EXCITED NUCLEI. Nosov, V. G.; Kamchatnov, A. M. Zh. Eksp. Teor. Fiz.; 65: No. 1, 12-23(Jul 1973). (In Russian).

The thermodynamics of the electromagnetic radiation from heated nuclei is developed on basis of the Landau theory of a Fermi liquid. The case of nonspherical nuclei is considered in which the quasiparticle energy spectrum is not distorted by the residual interactions which appreciably affect the thermodynamic behavior of the system. The number of quanta per cascade and mean-square fluctuation are calculated; the γ-quantum spectrum of the whole cascade is also obtained. The formulas can be used to determine the entropy and temperature of the initial nucleus by various methods. The effective nucleon (quasiparticle) mass in nuclear matter is determined by comparing with the experimental data. The region of validity of the theory and some possibilities of its extension on the basis of new experiments are discussed. (auth)

26272 (N−Z)/A DEPENDENCE OF THE PROTON IMAGINARY POTENTIAL AND THE THOMAS–FERMI GAS MODEL. Saharia, A. N.; Ahmad, I.; Haider, W. (Aligarh Muslim Univ., India). Nucl. Phys; A208: No. 3, 611-616(1973).

The Thomas–Fermi gas model for the nucleus was applied to study the $\epsilon = (N-Z)/A$ dependence of the proton imaginary potential in the energy range 30 to 60 MeV. As the ϵ-dependence in the empirical imaginary potential is exhibited almost exclusively and most unambiguously in the line integral of its surface term one takes the line integrals of the theoretical and the total empirical imaginary potentials as the basis for comparison. The predicted ϵ-dependence is found to agree well with the observed one. (auth)

26273 SPONTANEOUS POSITRON PRODUCTION IN COLLISIONS BETWEEN HEAVY NUCLEI. Popov, V. S. (Inst. of Theoretical and Experimental Physics, Moscow). Zh. Eksp. Teor. Fiz.; 65: No. 1, 35-53(Jul 1973). (In Russian).

It is shown that in collisions between a completely stripped («bare») nucleus (Z_2) and the atoms of a heavy target (Z_1) vacancies are formed in the K-shell of the united atom, providing $Z_2 \geq Z_1$. Therefore such collisions, as well as those between two bare nuclei, will result in spontaneous production of electron-positron pairs in a static coulomb field of the colliding nuclei if the nuclei approach each other at a distance $R < R_c$ (R_c is a critical distance at which the ground level of the discrete spectrum becomes as low as the boundary of the lower continuum). In this case one or two electrons fill the vacancies in the K-shell of the united atom and the positrons escape to infinity. This circumstance should make feasible the experimental observation of spontaneous production of positrons in an ordinary heavy target by a bare nuclear beam. The kinematics of the process is considered, and the threshold behavior of the positron production cross section and positron energy spectrum are considered. An estimate of background effects shows that they should not impede observation of the phenomenon. An experimental study of quasistatic positron production from vacuum due to lowering of the level to the lower continuum should be of interest from the viewpoint of verification of quantum electrodynamics in strong fields. (auth)

PHYSICS (PLASMA AND THERMONUCLEAR)

26274 (UCRL-50002-72) CONTROLLED THERMONUCLEAR RESEARCH. Annual Report, July 1971–June 1972. (California Univ., Livermore. Lawrence Livermore Lab.). 29 Sep 1972. Contract W-7405-eng-48. 189p. Dep. NTIS $7.60.

Separate abstracts were prepared for four of the included sections. (MOW)

For abstracts of individual sections see: 26284–26287.

Confinement and Heating

Refer also to abstracts 26332, 26333, 26348, and 26391.

26275 (AD-760808) ANALYSIS OF OPTICALLY THICK, DC-INDUCTION-HEATED ARC DISCHARGES. Schreiber, P. W.; Hunter, A. M. II; Taylor, P.; Benedetto, K. R. (Aerospace Research Labs., Wright-Patterson AFB, Ohio). Apr 1973. 78p. (ARL-73-73). NTIS.

An analytical study was made to determine the properties of arc discharges heated by combinations of induction and dc electromagnetic fields. Induction power is supplied to the discharge by a solenoidal coil whose axis of symmetry is aligned with the applied dc electric field. A numerical technique is used to simultaneously solve a set of linear differential equations which include Maxwell's field equations, the single fluid energy equation, the momentum balance equation, Ohm's law, and the radiation diffusion equation. A number of reasonable assumptions are made to obtain the final set of equations for programming. These assumptions restrict the calculations to azimuthally symmetric plasmas with axial gradients only in static pressure. In addition, the radiant energy flux is assumed to be isotropic within the plasma. (NTIS)

26276 (IAE-2184) CONDITIONS FOR OBTAINING A POSITIVE ENERGY BALANCE FOR A $\beta = 1$ PLASMA IN A TRAP WITH MAGNETIC MIRRORS. Bortnikov, A. V.; Brevnov, N. N. (Institut Atomnoi Energii, Moscow (USSR)). 1972. 10p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

The plasma may be obtained by rapid heating of a given amount of material with laser or electron beams. (tr-auth)

26277 (INR-P-1416) PARTICLE LOSS FROM THE SPHERICAL MULTIPOLE MAGNETIC TRAP. Sadowski, M.; Skladnik Sadowska, E.; Sudlitz, K.; Baranowski, J. (Institute of Nuclear Research, Warsaw (Poland)). 1972. 13p. INIS.

Investigations of the high-order SM configurations are summarized. A simple theoretical model of plasma effusion through an escape area is considered and the conclusions are compared with the experimental results. The measurements of particle loss through the point cusps along and perpendicular to the axis of plasma injection are also described. (auth)

26278 (IPP-1/133) INVESTIGATION OF ELECTRON HEATING DURING FAST MAGNETIC COMPRESSION OF LOW-DENSITY PLASMAS USING LIGHT-SCATTERING DIAGNOSTICS. Maret, G. (Max-Planck-Institut fuer Plasmaphysik, Garching (West Germany)). Apr 1973. 51p. (In German). Dep. NTIS (U. S. Sales Only) $4.75.

In a high-voltage theta pinch (charging voltage 500 kV, coil diameter 43 cm, coil length 100 cm) heating of low-density plasmas (initial density $n_0 \approx 1 \times 10^{13}$ cm^{-3}) to thermonuclear temperatures ($T_i \approx 15$ keV) is achieved by extremely fast magnetic-shock compression. In the present work, electron heating and loss mechanisms during and after compression are studied. The time development of the radial magnetic field profile is followed by probes (e.g., in 2-mtorr D_2: current sheath width about 4 cm $\approx 8\ c/\omega_{pe0}$, piston velocity $\approx 10^8$ cm/sec). $T_i \approx 15$ keV results from the measured neutron rate and electron density n_e. Density and electron temperature are measured by means of a 10° Thomson scattering experiment ($\alpha \ll 1$; ruby laser: 800 MW, 3 mrad; multichannel detection of spectrum) giving, just after compression of the plasma, $n_e = 3 \times 10^{13}$ cm^{-3} and $T_e = 700$ eV. An energy balance of the electrons demonstrates that classic ohmic heating, caused by electron–ion collisions and adiabatic compression, only results in $T_e \approx 30$ eV, whereas anomalous ohmic heating (characterized by an effective collision frequency $\nu_{eff} \approx 0.3\ \omega_{pi}$ as calculated from the skin-depth formula) results in $T_e = 3.1$ keV. The observed temperature of $T_e \approx 700$ eV, which is about 4 times smaller, can be explained by heat conduction parallel to the magnetic field if for the corresponding collision processes the same collision frequency as for the turbulent heating is used. Thus, the experimental results indicate that both heat conduction and anomalous resistivity are caused by the same microturbulence. (auth)

26279 (IPP-III-8) Rf-PLASMA HEATING WITH L-STRUCTURES. Lisitano, G.; Corti, S.; Bergbauer, M.; Capitanio, A.; van Heumen, A.; Reiter, A.; Rossetti, E. (Max-Planck-Institut fuer Plasmaphysik, Garching (West Germany)). May 1973. 31p. Dep. NTIS (U. S. Sales Only) $3.75.

Rf-wave-launching structures (L-coils) were excited in a stellarator and in a magnetic mirror machine. The characteristics of the discharge are presented. They cannot be explained by known wave–plasma interactions except by rf turbulence heating. (auth)

26280 (MATT-Q-30, pp 1-33) TOROIDAL CONFINEMENT EXPERIMENTS. Jun 1973.

In annual report covering the period January 1–December 31, 1972.

The following areas of research on the FM-1 spherator are discussed: (1) plasma confinement and fluctuations, and (2) basic phenomena of toroidal confinement. The ST Tokamak is discussed in terms of the following: (1) discharge time development for confinement, (2) the current density distribution, (3) rf wave heating, and (4) electron velocity distribution at large toroidal electric fields. A brief description of the PLT fabrication is given. (MOW)

26281 (MATT-Q-30, pp 34-43) THEORY. Jun 1973. In Annual Report Covering the Period January 1–December 31, 1972.

The report of the theoretical program is divided into four sections: (1) toroidal confinement, (2) plasma heating and parametric instabilities, (3) computer simulation, and (4) basic plasma physics and astrophysics. (MOW)

26282 (MATT-Q-30, pp 44-54) SMALL-MACHINE EXPERIMENTS. Jun 1973.

In annual report covering the period January 1–December 31, 1972.

The following research areas are briefly discussed: (1) enhanced absorption of hf electromagnetic waves, (2) nonlinear processes in rf plasma heating, (3) nonlinear wave processes near the lower-hybrid resonance frequency, and (4) stabilization of drift waves by coupling to damped modes. (MOW)

26283 (ORNL-TM-4332) NEUTRAL BEAM INJECTION INTO A TOKAMAK. I. Fast Ion Spatial Distribution for Tangential Injection. Rome, J. A.; Callen, J. D.; Clarke, J. F. (Oak Ridge National Lab., Tenn.). Sep 1973. Contract W-7405-eng-26. 41p. Dep. NTIS $4.25.

The production processes and spatial distribution of fast ions resulting from tangential injection of a diffuse neutral beam into a tokamak are discussed. The spatial distribution of fast ions for various injection trajectories and absorption mean free paths are calculated and discussed in detail. Maximum beam absorption for a parabolic density profile is shown to occur for injection roughly halfway between the inner wall of the torus and the magnetic axis; however, since this maximum is near unity and only weakly dependent on the injection trajectory, this is not the most important possible optimization. Since the drift orbit surface area over which the fast ions are distributed is roughly proportional to the distance from the magnetic axis, the fast ion density is found to be strongly peaked at the magnetic axis for present experiments where the absorption mean free path λ is comparable to the plasma radius a. This geometric peaking effect is strong enough to overcome the exponential beam attenuation and cause the fast ion density and consequent beam energy deposition to be peaked at the plasma center as long as $\lambda_0 \gtrsim a/4$. Charge exchange of the fast ions with neutrals in the plasma can deplete the fast ion population, particularly near the plasma edge. When charge exchange is an important loss mechanism, beam injection nearly tangent to the magnetic axis is found to maximize the beam effectiveness in heating. (6 figures, 21 references) (auth)

26284 (UCRL-50002-72, pp 12-47) THEORETICAL STUDIES. 29 Sep 1972.

In controlled thermonuclear research. Annual report, July 1971–June 1972.

During the past year the primary emphasis of the theory group was on supporting the two major CTR experiments at LLL, Mirror and Astron. This work can be subdivided into two main efforts: (1) computational, to simulate complicated physical phenomena relevant to the experiments, and (2) analytic, to explain the results of real and numerical experiments. (auth)

26285 (UCRL-50002-72, pp 48-105) MAGNETIC MIRROR PROGRAM. 29 Sep 1972.

In controlled thermonuclear research. Annual report, July 1971–June 1972.

The two most noteworthy scientific developments in the LLL Mirror Program during FY 1972 are: (1) The elucidation of loss processes in the 2X II confinement experiment, including the demonstration of quiescent decay modes, the decay rates for which are apparently in close agreement with recent theoretical predictions. (2) The achievement of collisionally randomized ion distribution functions in the Baseball II neutral injection experiment and the demonstration of resultant improved stability and increased plasma density relative to Baseball I. (auth)

26286 (UCRL-50002-72, pp 106-142) ASTRON PROGRAM. 29 Sep 1972.

In controlled thermonuclear research. Annual report, July 1971–June 1972.

The most important feature of the Astron program this fiscal year was the completion in July 1971 of the fast modulator facility, which provided the capability of injecting the 6-MeV, 600-A electron pulses of the Astron accelerator at a rate of 800 to 1000 pulses/sec in a burst of up to 20 or more pulses. The purpose of this facility is to stack electron pulses to build the E-layer up to the strength required to generate a pattern of closed magnetic lines, which has unique features for stable plasma confinement. (auth)

26287 (UCRL-50002-72, pp 143-156) TOROIDAL CONFINEMENT PROGRAM. Anderson, O. A.; Birdsall, D. H.; Hartman, C. W.; Hooper, E. B.; Munger, R. H. 29 Sep 1972.

In controlled thermonuclear research. Annual report, July 1971–June 1972.

The superconducting Levitron (SCL) research program is briefly discussed. Magnetic field configurations and plasma confinement and heating diagrams are shown. (MOW)

26288 PLASMA HEATING AT THE LOWER HYBRID RESONANCE. Tarasenko, V. F.; Kitsenko, A. B.; Panchenko, V. I.; Stepanov, K. N. (Physicotechnical Institute, Academy of Sciences of the Ukrainian SSR, Khar'kov). Sov. Phys.–Tech. Phys. 17: No. 9, 1599-1601 (Mar 1973).

It was shown experimentally that turbulent heating of both plasma components occurs when the fast magnetoacoustic wave is excited with large amplitude and that an intense small-scale parametric instability should be excited under typical conditions. The scattering of electrons and ions by turbulent pulsations was speculated to be the plasma heating mechanism. (CES)

26289 EXPERIMENTAL DETERMINATION OF MAGNETIC WELL DEPTH IN STELLARATORS. Aleksin, V. F.; Loktionov, Y. M.; Sebko, V. P.; Tyupa, V. I. (Physicotechnical Institute, Academy of Sciences of the Ukrainian SSR, Khar'kov). Sov. Phys.–Tech. Phys. 17: No. 9, 1492-1498 (Mar 1973).

A method is proposed for the experimental determination of the average minimum magnetic field in plasma confinement systems with combined magnetic fields, such as stellarators, heliotrons, and asymmetric stellarators. The method is based on the presence of helical and "quasihelical" symmetry in such systems, and it permits measurement of the magnetic well depth up to the separatrix in linear systems and in toroidal systems with large aspect ratio. To measure the magnetic well (that is, $\int dl/H$) it is necessary to determine the shape the magnetic surface and the behavior of the field lines along the surface. The presence of helical or quasihelical symmetry permits this to be done. Furthermore, it is necessary to know the map of the magnetic field in the volume bounded by the separatrix. The solution of the latter problem is simplified by the existence of the exact identity $\int dl/H = \int dz/H_z$; this effectively reduces to the measurement of the magnetic field H_z and the fundamental axial field H_0 in one or several cross sections where z=const. Two methods are used here to improve the accuracy of the measurement of the spatial distribution of H_z: differential–ballistic and differential–induction. The former permits measurement of a minimum field difference of about 1 G, and the latter, about 10^{-2} G. (auth)

26290 DIRECT OHMIC HEATING OF IONS IN AN IONIZING SHOCK. Bighel, L.; Cramer, N. F.; Millar, D. D.; Niland, R. A. (Univ. of Sydney). Phys. Lett., 44A: No. 7, 449-450(13 Aug 1973).

An experimental study of the structure of a normal ionizing shock in helium suggests that the shock is essentially resistive with the major dissipative mechanism being ohmic heating of ions and neutrals by ion currents. (auth)

26291 OBSERVATION OF PLASMA HEATING DUE TO PARAMETRIC INSTABILITIES AT THE UPPER HYBRID AND AT THE CYCLOTRON HARMONIC FREQUENCIES. Grek, B.; Porkolab, M. (Plasma Physics Laboratory, Princeton University, Princeton, New Jersey, 08540). Phys. Rev. Lett. 30: No. 18, 836-839 (30 Apr 1973).

Strong plasma heating is observed in external electric fields near the upper hybrid frequency or near the electron cyclotron harmonics. It is shown that the fast plasma heating is associated with the presence of the parametric instability of Bernstein waves, ion–acoustic waves, and lower hybrid waves. (auth)

26292 AN EFFICIENT PLASMA SURFACE-WAVE COUPLER. Sorensen, T. P.; Ristic, V. M. (Department of Electrical Engineering, University of Toronto, Toronto, Canada, M5S 1A4). Appl. Phys. Lett. 22: No. 10, 508-510 (15 May 1973).

A plasma surface-wave coupler consisting of interdigital metallic rings is described and the comparison between the theoretical and experimental results is presented. The coupling loss per coupler is 4 dB at the frequency of 52 MHz measured on an experimental setup consisting of a plasma tube and two couplers spaced 25 cm apart. The coupler is insensitive to slow–temporal and slow–spatial variations of the plasma frequency. The coupler can be used in plasma laser and plasma torch applications. (auth)

26293 PLASMA HEATING BY AN INTENSE ELECTRON BEAM. Miller, P. A.; Kuswa, G. W. (Sandia Laboratories, Albuquerque, New Mexico, 87115). Phys. Rev. Lett. 30: No. 20, 958-961 (14 May 1973).

An intense pulsed electron beam ($\nu/\gamma \sim 2$) was used to heat electrons in a target plasma in a magnetic field. A strong beam–plasma interaction was observed. Measured heating levels were found to be consistent with a two–stream instability calculation and return–current heating estimates. Energetic counter–streaming electrons were detected in the plasma during the beam pulse and possible sources of these electrons are suggested. (auth)

26294 HEATING OF MAGNETIZED PLASMA UNDER CONDITIONS OF PARAMETRIC INSTABILITY. Demirkhanov, R. A.; Khorasanov, G. L. (Sukhumi Physicotechnical Institute). High Temp. 10: No. 5, 1027-1028 (May 1973).

The heating of a magnetized plasma under conditions of parametric resonance at plasma densities higher than previously reported was studied. The Cs plasma parameters were as follows: radius of plasma filament, 3 cm; length of filament, 100 cm; density, (4 to 7) $\times 10^{10}$ cm^{-3}; initial plasma temperature, $T_e \sim T_i \sim$ 0.3 eV. The plasma filament was in a longitudinal homogeneous magnetic field of intensity 3.5 kOe. Plots of the electron temperature against the high-frequency voltage are shown; they are approximately linear, with the presence of a distinct heating threshold. The slope of the lines and the value of the threshold voltage vary when the frequency of the external field is varied, and this frequency dependence is also depicted. Increase of the plasma density from 5×10^8 to 5×10^{10} cm^{-3} does not change the physical picture of the parametric resonance and accompanying plasma heating. At the same time, there appears with increasing plasma density a pronounced instability threshold due to the damping of the plasma waves as a result of electron–ion collisions. (3 figures) (RWR)

26295 PARAMETRIC INSTABILITIES AND TURBULENT HEATING OF A PLASMA IN THE FIELD OF A FAST MAGNETO-ACOUSTIC WAVE. Kitsenko, A. B.; Panchenko, V. I.; Stepanov, K. N.; Tarasenko, V. F. (Physical-Technical Inst., Kharkov). Nucl. Fusion; 13: No. 4, 557-571(Aug 1973).

The parametric instability of a homogeneous plasma in a magnetic field $\vec{B}_0$ and in an alternating perpendicular electric field $\vec{E}_0$ is considered. The electric field frequency ω_0 is of the same order as the lower hybrid frequency ω_{LH}, while the amplitude of the relative velocity of the electrons and ions $u \sim cE_0/B_0$ is significantly less than the thermal velocity of the electrons. The excitation of longitudinal hydrodynamic oscillations in a cold plasma and ion sound and electron sound in a strongly nonisothermal plasma are considered. The characteristic values of the maximum growth rate of these oscillations is of the order of ω_{LH}. The results are presented of experiments on turbulent plasma heating by a fast magnetoacoustic wave excited by an alternating radial electric field ($f_0 = \omega_0/2\pi = 150$ MHz, plasma density $n_0 = 10^{12}$ to 10^{13} cm^{-3}, $B_0 \leq 5$ kG). Under conditions where $\omega_0 \sim \omega_{LH}$ there is rapid heating of the electrons and ions to 200 to 400 eV. The observed heating may be attributable to the excitation of a parametric instability. (auth)

26296 DRIFT-SURFACE-ISLAND FORMATION AND PARTICLE DIFFUSION IN TOROIDAL PLASMA. Brambilla, M.; Lichtenberg, A. J. (CEN, Grenoble, France). Nucl. Fusion; 13: No. 4, 517-520(Aug 1973).

Static electric fields, which vary around the major axis of a torus, are shown to give rise to islands in the drift surfaces of the particles, with flutelike perturbations as the most dangerous ones. The size of the islands in the ion drift surfaces can be a sizable fraction of the plasma radius, while electron-drift surface islands are smaller by the square root of the ratio of the Larmor radii. If a number of low-frequency waves of reasonably

high azimuthal wave number are present in a tokamak discharge, a series of islands exists which can give rise to enhanced electron diffusion. Since the electric field does not appear static to the ions, they are not affected in a similar fashion. The enhanced electron diffusion due to island formation is compared with another mechanism of enhanced diffusion which was recently proposed by Pogutse. (auth)

26297 SLAB MODELS FOR CLASSICAL DIFFUSION IN THE BELT PINCH. Bateman, G. (Institut fuer Plasmaphysik, Garching, Ger.). Nucl. Fusion; 13: No. 4, 581-594 (Aug 1973).

Classical diffusion is considered as a time-dependent and self-consistent problem for a free-boundary plasma in the plane slab and cylindrical slab geometries. These conditions approximate the Belt-Pinch experiment. It is found that the instantaneous diffusion rate changes rapidly as the plasma spreads and the fields decay. There is a succession of, at least, four physical phenomena which can dominate under different conditions: The poloidal electric field decays rapidly during an initial, finite-β, transient stage. The pinch effect due to the toroidal electric field may impede diffusion for an intermediate time span. After the pinch effects have become negligible, Spitzer diffusion induces a pressure decay which is algebraic with time and a poloidal B-field decay which is exponential with time. Although the pressure decay is initially faster, the rates soon become comparable. The Pfirsch–Schlüter effect enhances this diffusion only late in the discharge after the plasma has spread out and the rotational transform has decayed. A formula is also found for the radial position of the cylindrical slab as the fields decay. For passive field programming, there is a fixed but unstable position. (auth)

Diagnostics

Refer also to abstract 26346.

26298 (ORNL-TM-4354) THOMSON SCATTERING MEASUREMENTS IN ORMAK. Murakami, M.; Wing, W. R.; Culver, J. S.; Edmonds, P. H. (Oak Ridge National Lab., TN). Sep 1973. Contract W-7405-eng-26. 32p. Dep. NTIS $3.75.

Measurements were made of electron temperature in the tokamak-type discharge device, ORMAK, using light (from a Q-switched ruby laser) Thomson scattered by the plasma electrons. The measured temperature ranges from .20 to 1.2 keV for average densities of 1×10^{13} to 3×10^{13} cm^{-3}. The radial electron temperature profiles observed in stable discharges are broad (flat over about $\frac{1}{2}$ the limiter radius), while a tendency toward sharpened profiles appears when the discharges become unstable at low safety factor. β_p (plasma energy/poloidal magnetic field energy) is observed to ranges between 0.8 and to 0.3. The overall picture of the ORMAK plasma appears similar to that of a conventional tokamak, and no significant deleterious effects have been observed despite ORMAK's extension of the tokamak configuration to low aspect ratio, producing a nearly collisionless plasma. However, detailed studies must wait until the improved Thomson scattering device (SCAT-PAK) resolves the two major limitations of the present measurement: statistics of the scattered signal and plasma background noise. (auth)

26299 INTERFEROMETRIC MEASUREMENTS OF PARTICLE DENSITY IN CASCADE ARCS OF NORMAL PRESSURE. Baum, D. (Univ., Duesseldorf, Ger.). (1973). vp. (In German).

From spring meeting of the Deutsche Physikalische Gesellschaft: pulse physics, plasma physics, and gas discharges, quantum optics; Berlin, Germany (9 Apr 1973).

. The electron and neutral particle density was measured in a wall-stabilized cascade arc using a Mach–Zehnder interferometer with He–Ne laser (6,328 and 33,912 A). The arc cross section was 6 mm. The discharge current was 50, 100, or 150 amperes for the filling gases He, Ar, and Xe at a pressure of 1 atmosphere. (GE)

26300 MULTIMODE CAVITY MEASUREMENTS OF PLASMA DENSITY IN A TORSATRON. Voitsenya, V. S.; Voloshko, A. Y.; Dushin, L. A.; Skibenko, A. I.; Solodovchenko, S. I.; (and others). Sov. Phys.–Tech. Phys. 17: No. 9, 1481-1485 (Mar 1973).

A cavity method is described for measuring the plasma density (2.10^9–5.10^{11} cm^{-3}) in the Saturn stellarator-torsatron. By means of an open waveguide, axisymmetric 8-mm microwaves are excited in the vacuum chamber in the TM_{mnq} mode. A simple resonance-shift display that uses conventional equipment is described. The form factor, related to the plasma distribution in the chamber, is determined taking account of the magnetic surfaces in the torsatron. The results are compared with probe measurements. (auth)

26301 APPRAISAL OF THE MASS-SPECTROMETER DIAGNOSTIC TECHNIQUE IN THE STUDY OF AFTERGLOW PLASMAS. Smith, D.; Plumb, I. C. (Univ. of Birmingham, Eng.). J. Phys., D (London); 6: No. 12, 1431-1446 (8 Aug 1973).

The mass-spectrometer diagnostic technique, as applied to the sampling of positive and negative ions diffusing toward an orifice probe located at the boundary of an afterglow plasma is appraised. Several specific plasma situations are discussed and illustrated with data, including diffusion- and recombination-controlled positive-ion/electron plasmas and positive-ion/negative-ion plasmas. These examples emphasize the importance of spatial charge density distributions, space-charge sheaths, and electric fields in both the vicinity of the sampling orifice and in the body of the plasma. Data are also presented that graphically illustrate the serious effects that can result from contamination of the sampling electrode in the region of the orifice. The problem of collisional breakup of weakly bound "cluster" ions in the sampling system is also briefly discussed. It is suggested that the serious discrepancies that exist between reported values of a large number of reaction rate coefficients obtained from afterglow studies are due, at least in part, to a lack of appreciation of some of these important physical phenomena. (auth)

26302 PULSE X-RAY PHOTOGRAPHY OF A SHOCK WAVE IN CESIUM VAPOR USING TWO X-RAY TUBES. Sechenov, V. A.; Shchekotov, O. E. (Moscow Physicotechnical Institute). High Temp. 10: No. 5, 871-876 (May 1973).

An apparatus and a method for measuring the density and velocity of a shock wave from the absorption of soft x radiation using two x-ray tubes are described. Special attention is directed toward the accuracy of the method of determining the density. Possible sources of errors and ways of eliminating them are indicated. The accuracy of determining the density under the best possible conditions realized experimentally is 3%. (auth)

26303 MEASUREMENT OF DENSITY AND TEMPERATURE OF A HYDROGEN PLASMA USING AN ARGON LASER. Billman, K. W.; Stallcop, J. R. (Ames Research Center, NASA, Moffett Field, California, 94035). Appl. Phys. Lett. 22: No. 11, 565-567 (1 June 1973).

Curves relating the absorption of the argon ion laser lines at 0.488 and 0.515 μm to the electron density and plasma temperature of a hydrogen plasma are presented. A technique for determining these plasma parameters by means of simple absorption measurements is discussed. (auth)

26304 USE OF THE DIAMAGNETIC PROPERTIES OF A PLASMA TO DETERMINE ITS PARAMETERS IN THE PRESENCE OF AN EXTERNAL MAGNETIC FIELD. Lobov, G. D.; Shtykov, V. V. (Moscow Power Engineering Institute). High Temp. 10: No. 5, 990-991 (May 1973).

It has been shown that, inasmuch as external electromagnetic radiation causes the electrons of a plasma placed in a constant magnetic field to move along elliptical orbits, a magnetic moment is produced in the plasma in this case. Since the dependence of the resultant magnetization vector on the frequency of the electromagnetic field is determined by the plasma parameters, it becomes possible to use this phenomenon for plasma diagnostics. The magnetization vector produced in the local volume can be detected in various ways. If the microwave oscillations are modulated, then the measurement can be performed by detecting the emf induced in a coil. By varying the frequency of the applied radiation, the frequency dependence of the emf can be determined. In certain cases the number of electron collisions with the gas particles at the coil position and the electron concentration can then be easily deduced. (3 figures) (RWR)

26305 ELECTRICAL PROBE IN LOW-PRESSURE LOW-TEMPERATURE PLASMA. Part I. Current Methods of Interpretation of Measurement Results. Zakrzewski, Z. Pr. Inst. Masz. Przeply.; No. 61, 53-67 (1973). (In Polish).

Possibilities of determining the plasma potential as well as the density and temperature of electrons from the characteristics of an electric probe are discussed. Particular attention is drawn to the determination of the electron density in a low-pressure, low-temperature plasma. Present possibilities of interpreting the results of measurements taken by means of a probe are reviewed. The results of existing theories are represented in the form enabling the experimenter to utilize them in a direct way. Attention is drawn to the manners of simplifying the interpretation of the results of measurements taken by means of a cylindrical probe, the asymptotic cases of a thin probe and dense plasma. The possibility of constructing a "universal" characteristic of the probe in the form suited for direct comparisons with the measurement results is presented. (auth)

26306 INTERFEROMETRIC STUDY OF THE INTERACTION OF AN IONIZING SHOCK WAVE WITH A TRANSVERSE MAGNETIC FIELD. Loubsky, W. J. Stanford, CA; Stanford Univ. (1973). 174p. University Microfilms Order No. 73-20,494.

Thesis (Ph. D.).

A shock tube containing a magnetohydrodynamic generator section of the Faraday type was used to study the wave-interaction phenomena when ionized argon penetrates a strong transverse magnetic field. Time-resolved optical interferometry provided both a visualization and a quantitative assessment of the flow. Electron and mass density as well as induced-current measurements were analyzed and compared qualitatively with a one-dimensional theory that includes real-gas effects. A summary of the results and comparison is listed. (MOW)

26307 CYCLOTRON RADIATION FROM A RAREFIED INHOMOGENEOUS MAGNETOPLASMA. Engelmann, F.; Curatolo, M. (Euratom–Cnen, Frascati, Italy). Nucl. Fusion; 13: No. 4, 497-507(Aug 1973).

A comprehensive discussion of effects due to cyclotron radiation (volume power loss and supplementary electron heat conduction) in a rarefied plasma in a space-dependent magnetic field is given. Furthermore, the possibility of using cyclotron radiation as a diagnostic tool is investigated. (auth)

Kinetics (General)

26308 (IPP-6/119) INJECTION OF RELATIVISTIC ELECTRON BEAMS WITH ARBITRARY RADIAL PROFILES INTO WARM COLLISIONAL PLASMAS. Kueppers, G.; Salat, A.; Wimmel, H. K. (Max-Planck-Institut fuer Plasmaphysik, Garching (West Germany)). May 1973. 38p. Dep. NTIS (U. S. Sales Only) $4.00.

The results of previous authors for the injection of relativistic electron beams into unmagnetized collisional plasmas are generalized by allowing for arbitrary radial beam profiles and finite electron temperature. For $\nu t' \ll 1$ (ν = collision frequency of plasma electrons, t' = time after passing of the beam front) the magnetic field B depends strongly on the beam profile, smooth or sharp in units of the plasma skin depth c/ω_p. For $\nu t' \cong \nu t_D = (R\omega_p/c)^2 \gg 1$ (R = beam radius) the return current has diffused out of the beam and magnetic shielding is lost. For beam currents well above the Alfvén current, the beam pinches before reaching t_D. For beams with currents from 1 to 1000 times the Alfvén current and with $n'/n_e = 10^{-1}$ or 10^{-3} (n' = beam density, n_e = plasma density) critical times for which the beam is seriously affected or destroyed by pinching are calculated numerically. A parabolic and a step function profile are used for comparison, and the critical times are found to be only weakly dependent on the profile. The return-current heating time, which determines the maximum free path of the beam, is also calculated. Finite plasma temperature does not affect the magnetic field in this linearized theory. Its validity is estimated by evaluating critical times for the return current as well and comparing them with the critical beam times. (auth)

26309 COMPARISON OF ELECTRON AND ELECTRONIC TEMPERATURES IN RECOMBINING NOZZLE FLOW OF IONIZED NITROGEN–HYDROGEN MIXTURE. Part 1. Theory. Park, C. (Ames Research Center, Moffett Field, CA). J. Plasma Phys.; 9: No. 2, 187-215(Apr 1973).

Relaxation of the population distribution of electronic states is studied theoretically for a highly ionized nitrogen–hydrogen mixture expanding through a nozzle, wherein the hydrogen content is less than 0.1%. The analysis incorporates quantum-mechanical excitation rate coefficients and considers the effects of wall cooling and absorption of radiation. The electronic excitation temperatures are deduced from the computed population distributions along the nozzle, and are compared with the calculated electron temperatures; this shows a large discrepancy between the two. (auth)

26310 COMPARISON OF ELECTRON AND ELECTRONIC TEMPERATURES IN RECOMBINING NOZZLE FLOW OF IONIZED NITROGEN–HYDROGEN MIXTURE. Part 2. Experiment. Park, C. (Ames Research Center, Moffett Field, CA). J. Plasma Phys.; 9: No. 2, 217-234(Apr 1973).

Visible and infrared line radiations from nitrogen and hydrogen are measured with a spectrograph in an ionized flow expanding through a supersonic nozzle, wherein the hydrogen content is less than 0.1%. The experiment confirms quantitatively the predictions that the electronic excitation temperatures of hydrogen and (^3P) core states of nitrogen are higher than the electron temperature, and that (^3P) excitation temperatures exhibit maxima within the nozzle. The measured excitation temperatures of states with (^1D) core are found to agree with the calculated electron temperatures. (auth)

26311 RADIATIVE PROPERTIES OF HIGH-DENSITY ARGON PLASMA IN EXPLOSIVELY DRIVEN SHOCK WAVES. Bailey, R. T.; Burton, J. T. A.; Hicks, J. A. (Explosives Research and Development Establishment, Waltham Abbey, Eng.). Astronaut. Acta; 18: 117-125(Apr 1973).

A theoretical and experimental study has been made of the intense radiant emission from thermally ionized, high-density plasmas produced by explosively driven shock waves in some monatomic gases. In argon initially at atmospheric pressure, for example, it is shown that the explosive 60/40 RDX/TNT generates a shock propagating at 8300 m/sec (Mach 27) with a pressure close to 1 kb, a temperature of about 20,000°K, a degree of ionization of 75%, and a density of 14 kg/m^3. The real gas thermodynamic variables behind the initial and reflected shock waves are calculated for argon and helium and are used to estimate linear absorption coefficients based on Unsold–Kramer theory. Lowering of the first ionization potential due to the plasma microfield (the Unsold term) and energy level lowering effects arising from plasma polarization were taken into account. Under the conditions of these powerful shock waves, most of the line spectra are smeared out and are also masked by the free–bound and free–free (bremsstrahlung) transitions, which give rise to continuous radiation. For these optically thick plasmas, assumed in local thermodynamic equilibrium, the calculated values of the emitted spectral intensities were obtained from the continuous absorption coefficient using Kirchoff's law and correcting for stimulated emission and absorption by the plasma. In this way the radiant intensity at the surface of optically thick argon shocks was calculated and compared with values measured experimentally in the visible spectral region. (auth)

26312 EXCITATION OF OPEN RESONATOR WITH STARTING EMISSION OF STRONG-CURRENT DISCHARGE. Strashko, A. P.; Lutsenko, E. I.; Levanyuk, N. A.; Korzh, V. G.; Kuz'menko, V. V. (Kharkov State Univ.). Ukr. Fiz. Zh. (Russ. Ed.); 18: No. 5, 866-868(May 1973). (In Russian).

The possibility of the effective selection of the power of the starting epithermal emission from the plasma of a high-current discharge was studied. The geometric resonance of the plasma oscillations, arising during the development of beam instability in a high-current electrode discharge in the initial stages of its development was studied with an open resonator formed by two electrodes. The use of the resonator makes it possible to increase significantly the selection of the power of the high-frequency emission. (tr-auth)

26313 STUDY OF THE ELECTRON EMISSION PROCESSES IN A HOLLOW-CATHODE DISCHARGE. Willins, D. J.; Boyd, R. L. F. (University Coll., London). J. Phys., D (London); 6: No. 12, 1447-1454(8 Aug 1973).

A pulsed Langmuir probe was used to investigate the plasma in a hollow-cathode discharge run between a cylindrical cathode and an inner, coaxial, anode rod. By measurement of the ratio of the electron and ion saturation currents, it was established that secondary emission effects were negligible. Further, by comparison of the drop in current obtained at a hot probe when the discharge was extinguished with the current collected by the same probe when cold, it was shown that field enhancement of the thermionic emission is also negligible. Pure thermionic emission is thus shown to be the only significant process for electron emission from the probe. (auth)

26314 VELOCITY LIMITATION IN A ROTATING PLASMA DEVICE OF THE HOMOPOLAR TYPE. Himmel, G.; Piel, A. (Univ., Bochum, Ger.). J. Phys., D (London); 6: No. 12, L108-L111(8 Aug 1973).

The velocity limitation found by Angerth et al (Nucl. Fusion (Suppl) Pt 1, p 39) is confirmed by new measurements using an improved experimental technique. When this technique is extended to a helium–argon mixture, the behavior of the pure gases is observed again. Under certain conditions, a transition from the argon to the helium behavior takes place, probably caused by a separative effect. (auth)

26315 STUDY OF THE FEASIBILITY OF FUSION TORCHES. Sabri, Z. A. Madison, WI; Univ. of Wisconsin (1972). 733p. University Microfilms Order No. 73-10,737.

Thesis (Ph. D.).

Docility in design and malleableness in application of fusion torches are discussed. The need to exploit plasmas within the fusion range which are not yet explored by industry is examined together with a comparison between contemporary plasma jets and fusion torches. Three types of torches are considered for investigation; viz., an R-torch utilizing the exhaust of a thermonuclear reactor, an S-torch employing a specially designed plasma source, and an Sc-torch using no external source. (MOW)

Kinetics (Experimental)

26316 EMPIRICAL FACTOR FOR COLLECTIVE EFFECTS IN A NON-DEBYE PLASMA. Rovinskii, R. E. Sov. Phys.-Tech. Phys. 17: No. 9, 1499-1501 (Mar 1973).

The present basic source of information on transport processes in non-Debye plasmas is experiment. The experimental data show that good agreement with a theoretical model based on the electrical conductivity of a fully ionized Debye plasma can be achieved by introducing a factor which depends on the plasma parameters. It is convenient to interpret this factor as an effective ion charge Z_{eff}; in a non-Debye plasma the value of this "charge" is greater than the charge of a normal ion. Thus phenomenological factor Z_{eff} takes account of the collective interactions in the plasma. An empirical relation has been obtained for the effective charge: $Z_{eff}=\exp(an_e^{1/3}U_i/T^2)$, where a is a constant; n_e and T are the electron density and plasma temperature, U_i is the ionization potential. The Coulomb logarithm in Λ is replaced by the product $Z^2_{eff} \ln \Lambda_1$, where $\Lambda_1=\Lambda/Z_{eff}$, in the theoretical relations for the collison frequency and the electrical conductivity. (auth)

26317 RECOMBINATION RATE MEASUREMENTS IN NITROGEN. Douglas-Hamilton, D. H. (Avco Everett Research Laboratory, Everett, Massachusetts 02149). J. Chem. Phys. 58: No. 11, 4820-4823 (1 June 1973).

A method of generating an atmospheric pressure high-electron-density plasma with arbitrary electron temperature is described and applied to measurement of electron ion recombination rates in N_2. The recombination rate for N_2 is shown to be independent of pressure in the region investigated and is given as function of E/N and electron temperature. (auth)

26318 SCATTERING OF LASER LIGHT FROM A MAGNETICALLY STABILIZED HELIUM ARC. Meyer, J.; Potocnik, V. (Univ. of British Columbia, Vancouver). Phys. Lett., A; 45A: No. 2, 129-130(10 Sep 1973).

The spectrum of laser light scattered from a magnetically stabilized helium arc was measured. Aside from an enhancement near the plasma frequency, the measured spectrum agrees with the predicted profile for a thermal plasma of $kT_e = 10$ eV and $n_e = 10^{18}$ cm^{-3}. (auth)

Kinetics (Theoretical)

26319 (IPP-6/116) CRITICAL TIMES FOR OVERCRITICAL RELATIVISTIC ELECTRON BEAMS INJECTED INTO PLASMAS. Kueppers, G.; Salat, A.; Wimmel, H. K. (Max-Planck-Institut fuer Plasmaphysik, Garching (West Germany)). Feb 1973. 30p. Dep. NTIS (U. S. Sales Only) $3.50.

The theory of beam injection into unmagnetized plasma is extended by introducing, and discussing the relevance of, several criteria for propagation of cold, overcritical electron beams. Estimates of the criteria are given in terms of a simple beam-plasma model derived from linear injection theory. The influence of the radial beam profile upon the net magnetic field and, hence, on propagation, is taken into account. The validity of neglecting, as is customary in injection theory, the nonlinear magnetic force upon the plasma response is also studied. The parameter range of validity is estimated at the violation time of the Alfvén criterion. (auth)

26320 PLASMA FLUID EQUATIONS IN THE HIGH COLLISION-FREQUENCY LIMIT. Greene, J. M. (Flinders Univ. of South Australia, Bedford Park). J. Plasma Phys.; 9: No. 2, 261-274(Apr 1973).

The nature of the fluid approximation for plasmas in the high collision-frequency limit is examined in an effort to understand some of the limits of validity of the commonly used ideal magnetohydrodynamic equations. The plane wave dispersion relation for a homogeneous medium is evaluated. The dependence of the damping on the various dissipative terms is examined for each type of wave predicted by the dispersion relation. The effects of these terms are then compared, using the standard values for transport quantities with collision frequency larger than gyrofrequency. (auth)

26321 TENSORIAL SURFACE SPHERICAL HARMONIC EXPANSION OF COLLISION INTEGRALS FOR A WEAKLY IONIZED PLASMA. I. Schueller, V.; Wilhelm, J. (Univ., Greifswald, Ger.). Beitr. Plasmaphys.; 12: No. 6, 349-359(1972). (In German).

For a plasma consisting of electrons and heavy particles (ions, neutral particles) an approximate expression for the collision integral is deduced by Taylor series expansion of the integrand. Not only elastic but also inelastic collisions are taken into account, and the distribution of the heavy particles is assumed to be arbitrary. (auth)

26322 COULOMBIAN TRANSPARENCY IN A HOT INFINITE DEUTERIUM PLASMA ACCOUNTING FOR THE FINITE SIZE OF THE DEUTERONS. Mihailescu, I. N.; Ionescu-Pallas, N. J. (Inst. of Atomic Physics, Bucharest). Rev. Roum. Phys.; 18: No. 6, 793-798(1973).

Calculations of the Coulombian transparency are performed for deuteron radii of 0.5, 1, 2, 4, 6, 8, and 10×10^{-13} cm and temperature range between 10^{-1} to 10^{5}K. (MOW)

26323 MONTE CARLO SIMULATION OF RADIATION-INDUCED PLASMAS. Wang, B. S.; Miley, G. H. (Univ. of Illinois, Urbana). Nucl. Sci. Eng.; 52: No. 1, 130-141(Sep 1973).

A Monte Carlo simulation model for radiation-induced plasmas with nonlinear properties due to recombination was developed employing a piecewise-linearized predict-correct technique. Several variance reduction techniques are used, including antithetic variates. The resulting code is applied to the determination of the electron energy distribution for a noble-gas plasma created by alpha-particle irradiation. Results are presented for helium with an electron source rate from 10^{14} to 10^{18} electrons/(cm^3 sec), initial energies from 70 to 1500 eV, pressures from 10 to 760 torr, and electric-field-to-pressure ratios from 0 to 10 V/(cm torr). The low-energy portion of the distribution function approaches a Maxwellian for zero field and Druyvesteyn's distribution with an applied electric field. However, above the ionization potential and extending to the source energy, a parabolic-shaped distribution (tail) occurs. (auth)

26324 NUMERICAL METHODS FOR SOLVING SOME PROBLEMS OF THE THEORY OF PLASMA EQUILIBRIUM IN TOROIDAL CONFIGURATIONS. Zakharov, L. E. (Inst. of Atomic Energy, Moscow). Nucl. Fusion; 13: No. 4, 595-602(Aug 1973).

Numerical methods based on the virtual-casing principle are developed for solving some problems relating to the equilibrium of plasma in axially symmetric toroidal configurations with a transverse cross section of arbitrary shape. Methods are presented for calculating maintaining magnetic fields on the basis of a known equilibrium field at the plasma boundary, for extending numerically the equilibrium magnetic field beyond the plasma boundary, and for solving the direct equilibrium problem in the case of a quasi-uniform current. A method for obtaining some nonlinear solutions of the equilibrium equations is discussed. The paper also goes into the question of calculating an iron-free inductor and the question of determining the inductance of a toroidal superconductor of arbitrary transverse cross section. The methods described are illustrated by magnetic-field calculations for configurations of the "finger-ring" Tokamak type and the "Ohkawa doublet" type. (auth)

26325 PLASMA COOLING OF A PULSED THERMONUCLEAR REACTOR BY MEANS OF A NEUTRAL GAS LAYER. Oliphant, T. A. (Los Alamos Scientific Lab., NM). Nucl. Fusion; 13: No. 4, 521-527(Aug 1973).

The cooling of a pulsed theta-pinch-type fusion reactor after the burn by means of the introduction of a neutral-gas layer between the main plasma and the wall is discussed in terms of a simple mathematical model. The model assumes quasi-static heat flow and pressure balance and takes account of the fractional ionization of D-T gas at various densities and temperatures. The main result consists of an estimate of the initial injected neutral gas density required to remove the heat from the burnt and quenched fuel plasma in a given time for given reactor conditions. (auth)

26326 DISTRIBUTION OF THE TIME-DEPENDENT MICROFIELD IN A PLASMA. Roszman, L. J. (Institute for Basic Standards, National Bureau of Standards, Washington, D. C. 20234); Hooper, C. F. Jr. Phys. Rev. A 7: No. 6, 2121-2130 (June 1973).

The theory of the distribution of the time average of the time-dependent microfield in a quantum plasma taken over a finite time interval is introduced and developed. The short- and long-time limits are derived. The Wigner phase-space representation is employed to derive the correct distribution for a classical plasma and to establish a formalism which can be used for low-order quantum corrections. Numerical results are presented for a classical gas of charged noninteracting particles. It is found that for time-averaging intervals, which are larger than the time it takes a particle traveling with the average thermal velocity to cross the ion-sphere radius, the distribution deviates from the corresponding Holtsmark distribution for the quasistatic model. (auth)

26327 NONLINEAR MHD THEORY OF THE EXTERNAL MAGNETIC AND FLOW FIELDS OF FINITE FORCE-FREE PLASMAS. Siegel, J. M. Coral Gables, FL; Univ. of Miami (1973). 143p. University Microfilms Order No. 73-19,762.

Thesis (Ph. D.).

The magnetic and flow fields external to an inviscid, infinitely conducting, incompressible, azimuthally symmetric, spherical, force-free, equipartition plasma structure are investigated. The magnetic field and flow field are exactly determined if there are no currents or vortices in the region external to the plasma except for surface currents or surface vortices on the plasma boundary. The plasma's internal magnetic and flow fields are described in terms of external param-

eters. The external guidefield strength, B_o, and plasma propagation speed, V_o, are found to be related by $V_O = B_0$, the relation for Alfven speed. Finally, a finite transition layer approach in which all physical variables are required to be continuous across the boundary is investigated. (Diss. Abstr. Int., B.)

26328 KINETIC THEORY OF A COLLISION-DOMINATED PLASMA. Baus, M. (Univ. Libre, Brussels). Physica; 66: No. 3, 421-441(15 Jun 1973).

The kinetic theory of a classical electron gas is improved by taking into account higher-order collective effects describing collisional relaxation of the binary correlations. The resulting kinetic equation takes the form of a renormalized Balescu–Guernsey–Lenard equation, in which the free-particle propagators are replaced by collisional modes. This new kinetic equation conserves the total particle number, momentum and kinetic energy and satisfies an H-theorem. The most important modifications of the new collision term are discussed with respect to its BGL counterpart. (auth)

Production

Refer also to abstract 26323.

26329 (AD-754233) CHARACTERISTICS OF PLASMA PRODUCED BY THERMIONIC CATHODES WITH RADIAL ELECTRIC FIELDS. Martin, J. S.; Andrews, M. L. (Wright State Univ., Dayton, Ohio (USA)). Nov 1972. Contract F33615-69-C-1842. 57p. (ARL-72-152). NTIS.

A preliminary survey of the steady-state characteristics of four plasma sources developed for a mirror-machine experiment is described. All the sources included thermionic spiral cathodes to produce radial electric fields in the plasma. The sources tested were: (a) radial arc, (b) axial arc, (c) interdigital Lisitano coil with cathode, and (d) helical Lisitano coil with cathode. Distributions of electron temperature, ion density, and floating potential, together with local measurements of rms noise level and dominant oscillation frequencies, are presented. Plasma parameters were in the following ranges; electron temperature 10,000 to 80,000 K and ion density 10^9 to 10^{13}/cm^3. Typically, the floating potential varied parabolically with radius in the region influenced by the cathode. (auth)

26330 STARK BROADENING OF HIGH QUANTUM NUMBER $\Delta n = 1$ TRANSITIONS OF CARBON V AND VI IN A LASER-PRODUCED PLASMA. Irons, F. E. (Culham Lab., Abingdon, Eng.). J. Phys., B (London); 6: No. 8, 1562-1581(Aug 1973).

Stark-broadened-wavelength profiles of the hydrogen-like lines carbon VI (6 to 7) 3434, (7 to 8) 5290 Å and the quasi hydrogen-like lines carbon V (5 to 6) 2982, (6 to 7), 4945 Å were recorded, with time resolution, in the high-density plasma produced by the laser irradiation of a polyethylene foil in vacuum. Stark theory of relevance to those new lines is reviewed. Half-widths are calculated for values of electron and ion density deduced from line intensities, and are compared with experiment. It is shown that the broadening is predominantly ion quasi-static, with C^{6+} and C^{5+} as the principal perturbing ions. The electron-input contribution to the broadening would be at least as great as the ion contribution if it were not for correlations in the perturbations of the upper and lower states. There is a factor-of-two difference between theory and experiment, which is about the maximum that can be explained in terms of errors in the experiment and in the formulation of the Stark theory. (auth)

26331 ELECTRON TEMPERATURE AND IONIZATION STATE IN LASER-PRODUCED PLASMAS. Donaldson, T. P.; Hutcheon, R. J.; Key, M. H. (Queen's Univ., Belfast). J. Phys., B (London); 6: No. 8, 1525-1544(Aug 1973).

Neodymium glass laser pulses of up to 2-GW power, 10-ns duration, and focused flux densities up to 2×10^{13} W cm^{-2} were used to form plasmas at temperatures up to 450 eV. Plane solid-plastic targets with atoms of hydrogen, nitrogen, carbon, oxygen, and fluorine were used. The relation between laser flux density and electron temperature was studied and found to be of the form temperature $\propto$ (flux density)^x where $x = 0.40 \pm 0.05$. Both the power law and absolute temperatures are consistent with steady-state hydrodynamical theories predicting $x = 4/9$. Temperatures were deduced from soft-x-ray continuum emission using both relative and absolute intensities. The spatial features of the x-ray emission were observed with a pinhole camera. Grazing-incidence xuv photographic spectra were used to identify the highest degree of ionization in the plasma. The results were correlated with steady-state and transient ionization theories and with the measured electron temperature. Satisfactory agreement was found when self-absorption of resonance radiation was taken into account. (auth)

26332 ROLE OF MAGNETIC FIELDS IN SUPRATHERMAL PARTICLE GENERATION BY LASER-PRODUCED PLASMAS. Tidman, D. A. (Science Applications, Incorporated, Arlington, Virginia, 22209); Stamper, J. A. Appl. Phys. Lett. 22: No. 10, 498-499 (15 May 1973).

In this note we first use a simple circuit model to summarize the properties of the strong magnetic fields generated in laser-produced plasmas. It is pointed out that these fields are expected to increase the efficiency of suprathermal particle production near the critical depth. They would also cause energetic electrons to drift into the overdense regions of the target, giving rise to some emission of high-energy x rays. (auth)

26333 IGNITION AND MAINTENANCE OF A CW PLASMA IN ATMOSPHERIC-PRESSURE AIR WITH CO_2 LASER RADIATION. Smith, D. C.; Fowler, M. C. (United Aircraft Research Laboratories, East Hartford, Connecticut, 06108). Appl. Phys. Lett. 22: No. 10, 500-502 (15 May 1973).

The focused output from a high-power cw CO_2 laser is used to study the maintenance of a plasma in atmospheric-pressure air. The plasma is initiated externally by an electric spark and maintained by the absorbed laser beam energy. Ignition has also been observed when the laser was focused on a solid target. The maintenance threshold is examined as a function of beam diameter; for beams smaller than 1 mm the threshold power is $\approx$2 kW. When focused with lenses of 14-cm focal length and shorter, the plasma ball is stationary, situated slightly ahead of the focal point. For this focusing system, the transmission through the plasma was a function of incident power and increased with decreasing laser power. The value of the measured plasma absorption coefficient corresponds to an electron temperature of 14 000°K. When the laser beam was focused with 25-cm-focal-length mirrors or larger, the plasma was not stationary but propagated up the beam at a velocity of $\approx$10 m/sec toward the laser before extinguishing. The maintenance threshold of the plasma is discussed in terms of the loss channels from the plasma. (auth)

26334 ENERGY DISTRIBUTIONS OF ELECTRONS IN RADIATION INDUCED-HELIUM PLASMAS. Lo, R. H. K. Urbana, IL; Univ. of Illinois (1973). 131p. University Microfilms Order No. 73-17,304.

Thesis (Ph. D.).

Electron energy distributions resulting from a continuous primary source at high energies in helium are calculated. Contributions from both the primary electrons and subsequent secondaries are included. In the cases analyzed, the primary electrons are taken to be produced via the ionization of helium by heavy charged particles from the nuclear reaction ${}_0n^1 + {}_5B^{10} \rightarrow {}_3Li^7 + {}_2He^4$ which represents an important means of using the neutron flux from a nuclear reactor to produce a plasma. The calculation covers an energy range from zero to about 1 keV, the highest energy of the primary electrons associated with such a source. Electron–neutral collisions are assumed to be the dominate collision process. While this limits the fractional ionization to 10^{-5}, this region is of interest for application in areas such as radiation-pumped lasers and the buffer-gas region of the gaseous core nuclear reactor. (MOW)

Stability

Refer also to abstracts 25636, 26282, 26288, 26291, 26293–26295, 26379, and 26385.

26335 (AD-761173) SPATIAL GROWTH PROPERTIES OF PARAMETRIC AND BACKSCATTERING PLASMA INSTABILITIES. Fried, B. D.; Schmidt, G.; Gould, R. M. (California Univ., Los Angeles. Plasma Physics Group). Apr 1973. Contract N00014-69-A-0200-4023. 18p. (PPG-146). NTIS.

Simple general arguments are used to show that for instabilities resulting from the coupling of two weakly damped linear modes with oppositely directed group velocities, such as the various parametric instabilities, there exists a range of coupling strengths (pump power in the parametric case) for which the instability is convective; above this range the system is absolutely unstable. The ratio of absolute and convective instability thresholds is large whenever the damping lengths of the linear uncoupled modes have very disparate values. (auth)

26336 (AD-761174) STABILIZATION OF ION–ACOUSTIC WAVES BY ELECTRON TRAPPING. Albright, N. W. (California Univ., Los Angeles. Plasma Physics Group). Apr 1973. Contract N00014-69-A-0200-4023. 24p. (PPG-148). NTIS.

The unstable ion acoustic waves resulting from a beam of electrons entering a plasma are investigated. A test wave is considered that was introduced in the region of unstable waves through the same boundary that the beam enters the plasma. This test wave has an amplitude much larger than the noise. The growth

rate of this wave, including the effects of electron trapping and collisions, is calculated. It is found that such a test wave will stabilize by electron trapping. (auth)

26337 (IPP-1/132) MHD STABILITY OF HELICAL MODES IN A CYLINDRICAL TOKAMAK PLASMA. Grossmann, W.; Ortolani, S. (Max-Planck-Institut fuer Plasmaphysik, Garching (West Germany)). Apr 1973. 54p. Dep. NTIS (U. S. Sales Only) $4.75.

The consideration of realistic current-density profiles and more exact treatment of MHD stability leads to results that can be considerably different from those previously obtained. By numerically integrating the linearized ideal MHD equations of motion, more detailed and informative results can be obtained than by using the energy integral together with restrictive expansions and arbitrary test functions. One finds for a cylindrical tokamak-like plasma with a peaked-on axis current distribution that q = 1 at the limiter is not the stability condition, but that q must be much greater than unity for stability to m = 1 perturbations. Further, it is shown that a conducting shell has a negligible effect on m ≥ 2 modes for an on-axis peaked current distribution. (auth)

26338 INSTABILITY OF PLASMA WAVES WITH NONLINEAR LANDAU EFFECT. Martinov, N. K. (Univ., Sofia). Compt. Rend. Acad. Bulg. Sci.; 26: No. 3, 331-334(1973).

The problem of the instability of electrostatic plasma Langmuir oscillations and waves in electronic plasma, which interacts with a strongly oscillating external electric field, is discussed. The nonlinear Landau interaction is examined as a basic relaxation of the electron's energy and pulses. A dynamic variables formalism is used to find the correlation between electromagnetic fluctuations and induced charges and currents in the plasma. (MOW)

26339 LINEARIZED THEORY OF INHOMOGENEOUS MULTIPLE "WATER BAG" PLASMAS. Bloomberg, H. W.; Berk, H. L. (Coll. of William and Mary, Williamsburg, VA). J. Plasma Phys.; 9: No. 2, 235-247(Apr 1973).

The problem of the stability of inhomogeneous, electrostatic, multiple water-bag plasmas is considered. Equations are derived for general stationary water-bag equilibria, as well as for the corresponding perturbations. Particular attention is directed to systems with trapped particles in periodic equilibria, and special boundary conditions for the perturbation equations at the trapped-particle turning points are introduced. A normal-mode analysis is carried out for a configuration involving trapped particles occupying a finite region in the vicinity of the trough of an equilibrium wave (BGK mode). The results confirm the validity of the bunched-beam approximation. (auth)

26340 EFFECTS OF COLLISIONS ON THE DRIFT-CYCLOTRON INSTABILITY. Yu, M. Y. (Univ. of Umeaa, Sweden). Phys. Scr.; 8: No. 1-2, 70-72(1973).

The effect of collisions on the drift-cyclotron instability in a plasma is considered by means of a model Fokker–Planck kinetic equation. The results are compared with those of other authors who used different collision models. It is shown that the growth rates of the instability agree with those obtained iteratively from the full Fokker–Planck equation. (auth)

26341 EFFECT OF FINITE RESISTIVITY ON THE DYNAMIC STABILITY OF A COMPOSITE PLASMA. Bhatia, P. K.; Gupta, P. N. (Jodhpur Univ., India). Phys. Scr.; 7: No. 4, 179-182(1973).

The dynamic stability of a composite hydromagnetic plasma is investigated to include simultaneously the effects of collisions with neutrals, Hall currents, and finite resistivity. The prevalent magnetic field is assumed to be uniform and horizontal. It is first shown that the solution is characterized by a variational principle. The explicit solution is then obtained, by making use of the existence of the variational principle, for a semi-infinite composite plasma in which the density has a one-dimensional gradient along the vertical. It is found that the influence of the simultaneous inclusion of the effects of finite resistivity, Hall currents, and frictional effects with neutrals is destabilizing. (auth)

26342 SCREW INSTABILITY IN A PLASMA WITH A DISTRIBUTED CURRENT. Dnestrovskii, Y. N.; Kostomarov, D. P.; Popov, A. M. (M. V. Lomonosov Moscow State University). Sov. Phys.–Tech. Phys. 17: No. 9, 1463-1468 (Mar 1973).

The growth rate of the screw instability is calculated numerically as a funtion of the current density profile, the plasma density, and the position of the conducting wall. The stability of a plasma with a nonmonotonic current distribution and plasma density is studied. The stability of configurations with currents flowing in opposite directions in the region near the axis and at the periphery of the plasma is also treated. The stabilization of the screw instability by feedback is also studied for the case of a distributed current. (auth)

26343 ANODE SHEATH INSTABILITY AND HIGH-ENERGY ELECTRONS IN A LOW-PRESSURE DISCHARGE IN A TRANSVERSE MAGNETIC FIELD. Barkudarov, E. M.; Kervalishvili, N. A.; Kortkhondzhiya, V. P. (Physics Institute, Academy of Sciences of the Georgian SSR, Tbilisi). Sov. Phys.–Tech. Phys. 17: No. 9, 1526-1529 (Mar 1973).

The stability of the anode sheath with magnetized electrons in a high-voltage low-pressure discharge in a transverse magnetic field is studied. An inverse-magnetron discharge device is used. The anode sheath is unstable in the steady state. The instability appears when the electron density in the sheath approaches the equilibrium value $n_{e0} = (1/4\pi mc^2)(\nu_i/ n_0)H^2$ and many of the electrons are displaced to the cathode along the lines of force, leading to expansion of the anode sheath (ν_i is the ionization rate, ν_0 is the frequency of collision between electrons and neutral particles, and H is the magnetic field). Then the electron density in the sheath increases again and the process repeats itself. The electron accumulation in the sheath is described by diffusion theory. (auth)

26344 STABILITY OF A WEAKLY IONIZED ISOTHERMAL PLASMA IN A MAGNETIC FIELD. Bulanin, V. V.; Zhilinskii, A. P. (M. I., Kalinin Polytechnic Institute, Leningrad). Sov. Phys.–Tech. Phys. 17: No. 9, 1474-1480 (Mar 1973).

Experimental data on the stability of a decaying isothermal plasma in a uniform magnetic field are given. The plasma decay is investigated in cylindrical containers 1.2 and 4.4 cm in diameter, at gas (helium) pressures of 0.1–1.3 mm Hg, in magnetic fields up to 5000 Oe. Plasma oscillations develop when $\Omega_e\Omega_i/\nu_e\nu_i > 4$–9. ($\Omega_{e,i}$ are the electron and ion cyclotron frequencies and $\nu_{e,i}$ are cyclotron frequencies for the charged particles.) The oscillation parameters depend on the density and density gradient of the unperturbed plasma. The data obtained indicate that the instability is connected with the breakdown of neutrality over distances comparable with the wavelength. Experimental results that support the theory of this type of drift instability are noted. (auth)

26345 NONLINEAR INSTABILITY DUE TO PARAMETRIC INTERACTION OF WAVES IN A PLASMA. Martinov, N. K. (Univ., Sofia). J. Phys., D (London); 6: No. 12, 1426-1430(8 Aug 1973).

The possibility for the development of a nonlinear instability when two cyclotron-harmonic Bernstein-mode waves interact parametrically in the presence of a strong external oscillating electric field is examined. By investigating the dispersion equation, the conditions and increment of amplification of the waves of instability are determined in the case of an electronic Maxwellian plasma. Effects of transverse diffusion and nonmonochromatism of the external field on the development of the instability are estimated. (auth)

26346 ROTATION AND STRUCTURE OF LOW-FREQUENCY OSCILLATIONS INSIDE THE ST-TOKAMAK PLASMA. Hosea, J. C.; Jobes, F. C.; Hickok, R. L.; Dellis, A. N. (Plasma Physics Laboratory, Princeton University, Princeton, New Jersey, 08540). Phys. Rev. Lett. 30: No. 18, 839-842 (30 Apr 1973).

Low-frequency oscillations, which can lead into the violent disruptive instability which sets the q (current) limit of tokamak operation, are investigated with a heavy-ion beam probe. Direct measurements of the space potential and the perturbation of the electron density inside the hot tokamak plasma resolve the electric field contribution to the mode rotation and the spatial structure of the mode. (auth)

26347 MAGNETIC BRAIDING IN A TOROIDAL PLASMA. Stix, T. H. (Plasma Physics Laboratory, Princeton University, Princeton, New Jersey, 08540). Phys. Rev. Lett. 30: No. 18, 833-835 (30 Apr 1973).

Minute deviations from symmetry in the plasma current flow pattern are sufficient to break up magnetic surfaces and braid the lines of force in a toroidal plasma under magnetic confinement. Magnetic braiding can be expected to enhance current penetration, electron heat transport, and particle loss rates; sudden onset of braiding may be accompanied by voltage spikes. (auth)

26348 SOME ASPECTS OF THE DEVELOPMENT OF THE IONIZATION STABILITY ON A NONSTATIONARY BACKGROUND. Kas'yanov, V. A. (Moscow Power Institute). High Temp. 10: No. 5, 857-860 (May 1973).

The development of the ionization stability in a weakly ionized plasma during its Joule heating depends strongly on the initial conditions. It is shown in the linear approximation in the fluctuation of the electron density that the development time of the ionization instability may be appreciably shorter than the relaxation time of the electron density at large ratios of the Joule heating to the elastic losses at the initial instant of time. If the predominant mechanism of energy loss by the electron gas is elastic electron–ion collsions, the ionization instability can develop when $\Omega\tau$ is less than $\Omega\tau_c$, the critical Hall parameter for steady-state conditions. (auth)

26349 DIFFUSION DUE TO PARAMETRIC INSTABILITY TURBULENCE. Thomson, J. J. (Lawrence Livermore Lab., CA). Phys. Lett., A; 45A: No. 2, 111-112(10 Sep 1973).

The diffusion coefficient is derived for a weakly turbulent plasma in the presence of a driver field, $E_0 \cos \omega_0 t$, and low-velocity components due to diffusion are found at the beat phase velocity, $(\omega - n\omega_0)/k$. (auth)

26350 GROWTH OF ELECTRON-TRAPPED DRIFT INSTABILITY WITH MAGNETIC SHEAR. Okabayashi, M. (Princeton Univ., NJ). Contract AT(11-1)-3073. Phys. Lett., A; 45A: No. 1, 27-28(27 Aug 1973).

Finite parallel wavelength is taken into account to discuss the growth rate of electron-trapped drift instability with sheared toroidal magnetic system. The growth rate decreases with shear length for the case of long-connection length. (auth)

26351 ION-ION HYBRID RESONANCES OF H_2 AND D_2 DISCHARGES. Schlueter, H.; Schuerger, G. (Ruhr Univ., Bochum, Ger.). Phys. Lett., A; 45A: No. 2, 81-82(10 Sep 1973).

Ion-ion hybrid resonances are observed at a positive column. Violations of theoretical predictions previously reported by Buchsbaum are not observed. The effects of finite components of the propagation constant in the magnetic field direction are considered. (auth)

26352 SELF-ACTION OF ELECTROMAGNETIC WAVE IN PLASMA UNDER PARAMETRIC INSTABILITY. Vaskov, V. V. (Radio Inst., Moscow); Gurevich, A. V. Phys. Lett., A; 45A: No. 1, 47-48(27 Aug 1973).

The self-action of a strong electromagnetic wave in an inhomogeneous plasma is considered near the plasma resonance. (auth)

26353 EFFECTS OF A HIGH FREQUENCY EXTERNAL FIELD ON TRANSVERSE MAGNETIC DRIFT MODE OSCILLATION. Gupta, M. R. (Univ. of Calcutta). Indian J. Phys.; 47: No. 5, 257-266(May 1973).

The stabilizing effect of a high-frequency external field, $E_0 \cos \nu t$, on drift oscillations in an inhomogeneous plasma was studied. It is found that for $T_e > T_i$ if $\nu \lesssim |\omega_{H_e}|$ where ω_{H_e} is the electron cyclotron frequency, nonresonant mode coupling caused by $E_0 \cos \nu t$, diminishes the growth rate of unstable magnetic drift modes and actually stabilizes the mode if it is weakly unstable. For $\nu \gtrsim |\omega_{H_e}|$ the growth rate is accentuated. (auth)

26354 RUNAWAY-ELECTRON DISCHARGE REGIME IN THE TOKAMAK-6 DEVICE. Vlasenkov, V. S.; Leonov, V. M.; Merezhkin, V. G.; Mukhovatov, V. S. (Inst. of Atomic Energy, Moscow). Nucl. Fusion; 13: No. 4, 509-516(Aug 1973).

Experimental studies are described on a discharge in the Tokamak-6 device with a specific instability whose appearance coincidences with a sudden jump in the transverse energy of the plasma. It is shown that in these discharge regimes the current is carried by a relatively small group of runaway electrons with energies of 10 to 500 keV, while the main plasma with $\bar{n}_e \simeq 3 \times 10^{12}$ cm^{-3} has a low temperature (T_e, $T_i \sim 10$ eV) and carries practically no current. Pre-ionization of the working gas or the introduction of a relatively small (~2 to 3%) local inhomogeneity in the longitudinal magnetic field converts these runaway discharges into normal tokamak discharges. (auth)

26355 ANOMALOUS TRANSPORT DUE TO THE DISSIPATIVE TRAPPED-ION INSTABILITY. Dobrowolny, M. (European Space Research Inst., Frascati, Italy); Nocentini, A. Nucl. Fusion; 13: No. 4, 629-631(Aug 1973).

The lower frequency trapped-ion modes in toroidal configurations are investigated. The anomalous transport of trapped particles and heat arising in the presence of the dissipative trapped-ion instability are analyzed. Expressions for the dissipative instability, particle flux, and heat flux are derived. (MOW)

26356 PARAMETRIC PHENOMENA IN A PLASMA. Galeev, A. A.; Sagdeev, R. Z. (Inst. of High Temperatures, Moscow). Nucl. Fusion; 13: No. 4, 603-621(Aug 1973).

The theory of parametric instabilities of a plasma in a high-frequency electric field is reviewed. The general features of the decay instability of low-amplitude pump waves are illustrated on the basis of a simple model of a wave medium with wave phase velocity periodic in time. The changes in the nature of the instability with increasing pump wave amplitude are discussed. Instability thresholds were found with allowance for the dissipation and convection of perturbations in an inhomogeneous plasma. The effective frequencies of collisions characterizing the absorption of high-frequency field energy by a plasma were found. The problems of the existing theory, viz. the appearance of non-Maxwellian tails in the electron distribution, and the formation of plasmon condensates in a plasma with rare collisions are studied. The application of the methods to other aspects of the mechanics of continuous media is given, using as an example the dynamics of waves on the surface of a liquid. The interrelationship between the theories of wave stability developed by specialists in mechanics and plasma physicists is discussed. (auth)

Thermonuclear Engineering and Equipment

Refer also to abstracts 26289 and 26876.

26357 (BNWL-B-162 FUSION-FISSION (HYBRID) SYSTEMS: A CONTRIBUTION TO THE FCST REPORT ON ASSESSMENT OF ENERGY TECHNOLOGIES. Leonard, B. R. Jr.; Wolkenhauer, W. C. (Battelle Pacific Northwest Labs., Richland, Wash.). 29 Feb 1972. Contract AT(45-1)-1830. 15p. Dep. NTIS $3.00.

The following aspects of combined fusion-fission hybrid systems are discussed: (1) economics, (2) environmental quality, (3) resource preservation, and (4) strategy for research and development. (MOW)

26358 (IPP-1/130) LINEAR l = 1 STELLARATOR EXPERIMENTS USING A SHAPED COIL. Fuenfer, E.; Kaufman, M.; Lotz, W.; Neuhauser, J.; Schramm, G.; Seidel, U. (Max-Planck-Institut fuer Plasmaphysik, Garching (West Germany)). Feb 1973. 43p. Dep. NTIS (U. S. Sales Only) $4.25.

Linear theta-pinch experiments on ISAR I with a superposed helical l = 1 field are reviewed. The helical magnetic field is generated by shaping the main theta coil. Equilibrium and stability of the helical pinch are studied over a wide range of plasma parameters. The helical equilibrium is found to be in reasonable agreement with existing theories. Short-wavelength helical m = 1 oscillations are observed in connection with the helix formation. The strong damping of these oscillations (Alfvén waves) is explained in terms of phase mixing as a consequence of the diffuse density profile. Long-wavelength m = 1 instabilities are observed for $\beta \gtrsim 0.4$. Their growth rates are in reasonable agreement with sharp boundary theory if the ends are assumed to be fixed. Perturbations ($m \geq 2$) produced by the fast compression are damped away in the adiabatic phase, i.e., these modes are not unstable modes of the static equilibrium. (auth)

26359 (IPP-4/103) TECHNOLOGICAL DEVELOPMENTS TOWARDS A FUSION REACTOR. Daenner, W. (Max-Planck-Institut fuer Plasmaphysik, Garching (West Germany)). Nov 1972. 20p. (In German). Dep. NTIS (U. S. Sales Only) $3.00.

Fusion reactor development is closely connected with system-independent technology as well as with the growth of the system-dependent technologies dictated by progress in plasma physics. Of the system-independent technology, the most important aspects are material research, lithium technology including the problems of tritium recovery, theoretical and experimental neutron physics, and nuclear power station technology. All these topics arise from present nuclear technology, the methods of which, however, have to be directed to new materials and to harder conditions. The main problems to be solved are outlined. From the technological point of view, determination of the critical path necessitates initiating the system-independent technology as soon as possible. Some considerations are added concerning safety and economy of fusion power plants. (auth)

26360 (IPP-9/9) EROSION, GAS TRAPPING, AND RE-EMISSION AT THE FIRST WALL OF A FUSION REACTOR: LITERATURE SURVEY AND COLLECTION OF DATA FOR CHAPTER 2 OF THE GERMAN FUSION TECHNOLOGY MEMORANDUM. Scherzer, B. M. U. (Max-Planck-Institut fuer Plasmaphysik, Garching (West Germany)). Mar 1972. 37p. (In German). Dep. NTIS (U. S. Sales Only) $4.00.

A survey of literature on sputtering, gas trapping, and re-emission of hydrogen and helium in metals was made. It was the aim of the work to collect relevant data needed for an assessment of erosion, pumping and emission of impurities of the first wall of a fusion reactor, and to check for serious gaps. The survey contains literature up to the end of 1971. (9 figures, 66 references) (auth)

26361 (MATT-Q-30) ANNUAL REPORT COVERING THE PERIOD JANUARY 1-DECEMBER 31, 1972. (Princeton Univ., N. J. Plasma Physics Lab.). Jun 1973. Contract AT(11-1)-3073. 153p. Dep. NTIS $9.75.

Separate abstracts were for four of the included sections. (MOW)

For abstracts of individual sections see: 26280-26282, and 26362.

26362 (MATT-Q-30, pp 55-90) ENGINEERING AND DEVELOPMENT. Jun 1973.

In annual report covering the period January 1-December 31, 1972.

Major projects for this year were completion of the ATC machine and initiation of manufacture of the PLT machine. Miscellaneous engineering activities in support of existing experimental machines continued. The Reactor Studies Program completed its first full year of operation. (auth)

26363 (UCRL-74935) CRYOGENIC ENGINEERING AND FUSION POWER. Taylor, C. E. (California Univ., Livermore. Lawrence Livermore Lab.). 6 Aug 1973. 18p. (CONF-730805-9). Dep. NTIS $3.00.

From cryogenic engineering conference; Atlanta, Georgia, USA (8 Aug 1973).

Several superconducting coil systems for tokamaks, magnetic mirrors, and theta pinch fusion reactors are described. Engineering problems associated with each of these concepts are discussed. (MOW)

26364 SPARK CIRCUIT-BREAK DISTANCE. Friedrich, F. J.; Kind, D.; Salge, J.; Naglik, M. (to Kernforschungsanlage Juelich GmbH). German Patent 2,140,642. 22 Feb 1973. 13p. (In German).

A switching gap for high voltages is described consisting of electrodes partly connected with resistors and capacitors to keep the reference potential partly connected with the ignition pulses. The circuit may be subdivided into series and parallel connected meshes. Furthermore, some characteristics of the circuiting (coupling to voltage supply, polarity changes of the sources) and the materials used (isolating gases, oil, plastic foils) are specified with respect to the intended application in plasma fusion devices. (GE)

26365 DEVICE FOR PERFORMING A CONTROLLED THERMONUCLEAR FUSION OF HYDROGEN. Genswein, A. German Patent 2,140,445. 22 Feb 1973. 15p. (In German).

This device combines an electric discharge as multiple filaments in a magnetic field (resulting in figure-8 confinements) with parallel and series-connected pulsed lasers. The parameters for optimal operation (i.e., surmounting the fusion threshold) are specified: frequency of laser light, strength of the magnetic field, angle of incidence of laser light, configuration of mirrors, etc. (GE)

26366 OPTIMUM SHAPE OF A TOROIDAL SOLENOID. Shafranov, V. D. (I. V. Kurchatov Institute of Atomic Energy, Moscow). Sov. Phys.-Tech. Phys. 17: No. 9, 1433-1437 (Mar 1973).

For a given surface area or a given perimeter of the cross section the magnetic energy stored in a magnetic coil depends on the shape of the cross section. We calculate the optimum shape of the cross section of toroidal coils. For small toroidicity the optimum cross sections are circular; as the toroidicity of the solenoid increases, the cross section is stretched out along the principal axis of the torus. Examples are presented of the selection of optimum toroidicity of coils. It is shown that a coil which is optimum from the point of view of stored energy is also optimum from the point of view of mechanical strength. (auth)

26367 MIGMA PRINCIPLE OF CONTROLLED FUSION. Maglich, B. C. (Rutgers-The State Univ., New Brunswick, NJ). Nucl. Instrum. Methods; 111: No. 2, 213-235(1973).

The principles for a continuously operating, nonplasma, nonthermal, fusion power source are presented. The fuel is a 2-MeV deuteron beam which is injected, "de-beamed" and "self-collided" through precession; the d-d reaction breeds a ^{3}He-d self-colliding mixture ("migma") which is the main source of fusion power. Because of continuing replenishment, the migma does not become Maxwellian. Direct conversion of fusion energy into electricity is accomplished by deceleration of the positively charged ions (fusion products). An elemental power source ("migmacell") that can be built within the bounds of available technology would have a radius of 5 cm and deliver between 10 mW and 10 W of net electric power, depending on the assumptions on the space-charge limit. Ideas to increase the net power output, including local macro-neutralization, are indicated. Various ways are outlined to combine a large number of the migmacells into a 3-dimensional matrix to make a reactor capable of generating 10 kW of electric power. (auth)

26368 BOLOMETRIC METHOD FOR DETERMINING THE HEAT FLUX FROM A PLASMA TO A DIELECTRIC IN PULSED EROSIONAL ACCELERATORS. Gubarev, V. Y.; Kozlov, N. P.; Leskov, L. V.; Protasov, Y. S. (N. É. Bauman Higher Technical School, Moscow). High Temp. 10: No. 5, 1025-1026 (May 1973).

Experiments were carried out in an experimental unit and a model of an accelerator. The dielectrics used were Teflon and Plexiglas. The discharge was triggered along the surface of the dielectric by a low-power plasma injector of the Bostik type, located at the internal electrode. The recording instrument was a low-lag, three-layer bolometer, with a Bi thermal resistance, spray-deposited on Al foil from the side opposite to the incident flux and insulated from the foil by a layer of aluminum oxide. The change in thermal resistance with time, due to heating up of the plate, was measured. The bolometer, in a Cu shield, was placed in a Teflon cartridge, which was installed in the interelectrode gap. The results of measurements of the heat flux to a dielectric are in good agreement with data obtained in other ways. (2 figures) (RWR)

26369 CONTROLLING THE HIGH-TEMPERATURE STATE OF MATTER. UKAEA's Culham Laboratory. Energy Dig.; 2: No. 4, 2-6(Jul 1973).

A summary report is presented on the work of the UKAEA Culham Laboratory and, in particular, the progress and future program of research into nuclear fusion. The work on toroidal systems is described and the stages envisaged in the development of a fusion reactor are outlined. International cooperation in the field of fusion research is discussed, including plans for an integrated programme in Euratom. (UK)

26370 DIRECT CONVERSION OF THERMONUCLEAR PLASMA ENERGY BY HIGH MAGNETIC COMPRESSION AND EXPANSION. Oliphant, T. A. (Los Alamos Scientific Lab., NM); Ribe, F. L.; Coultas, T. A. Nucl. Fusion; 13: No. 4, 529-532(Aug 1973).

The useful work output from the magnetic compression, decompression, and α-particle energy deposition of a single cycle of a D-T Θ-pinch reactor is investigated. The intrinsic thermodynamic efficiency of the direct conversion cycle from α-particle energy to work is 62%. The direct-conversion output work is available to the reactor system at essentially 100% efficiency and has an appreciable effect on the circulating power fraction and plant efficiency. (auth)

26371 MAGNETIC-ISLAND FORMATION AND DESTRUCTION IN A LEVITRON. Freis, R. P. (Univ. of California, Livermore); Hartmann, C. W.; Hamzeh, F. M.; Lichtenberg, A. J. Nucl. Fusion; 13: No. 4, 533-548(Aug 1973).

The effect of nonaxisymmetric perturbations on the magnetic surfaces of a levitron is investigated. A Hamiltonian theory is developed for predicting the formation of both primary and secondary magnetic islands for the main resonances. Numerical calculations are made for a range of levitron parameters and compared with results of the Hamiltonian theory. Good agreement is obtained both for island width and for local rotational transform of the islands. A simple criterion for island destruction and the consequent stochasticity of the field lines agree well with numerical results. A ring tilt of 0.5 degree is found to destroy the magnetic surfaces in the neighborhood of the main resources ($i = \pi, 2\pi$). (auth)

26372 PERTURBATION OF THE MAGNETIC CONFIGURATION OF A STELLARATOR BY A LONGITUDINAL CURRENT IN THE PLASMA. Aleksin, V. F.; Sebko, V. P.; Sizaya, E. N.; Tyupa, V. I. (Physical-Technical Inst., Kharkov). Nucl. Fusion; 13: No. 4, 573-580(Aug 1973).

The structure of the magnetic surfaces of a rectilinear stellarator containing a plasma through which a straight longitudinal current flows is considered. The three cases of uniform, bell-shaped and parabolic current density distribution of a longitudinal current (cases of practical importance) are investigated. In the case of a uniform current distribution it is shown that if the rotational transform due to the current adds to that due to the vacuum field, the size of the separatrix decreases and, at some critical value of the current, the separatrix shrinks to a point (resonance case). In the case of bell-shaped (or parabolic) radial current-density distribution, the magnetic surfaces of the stellarator can acquire a rosette structure. When the longitudinal current attains certain values, the separatrix is uncovered, i.e., the magnetic configuration is broken up. The conditions for the appearance of rosettes of a definite type and those for the breakup of magnetic surfaces are derived analytically. (auth)

26373 MULTIPOLE TOKAMAK EQUILIBRIA. Feneberg, W.; Lackner, K. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). Nucl. Fusion; 13: No. 4, 549-556(Aug 1973).

Solutions are given for axisymmetric MHD equilibria obtained by superposing the magnetic field of the plasma currents and the field of current-carrying conductors situated outside the plasma. These equilibria were numerically calculated by several different iteration methods for solving the nonlinear free-boundary problem. They can describe experiments in which the discharge time is long compared with the diffusion time of the magnetic field through the external conducting walls. Equilibria were obtained both for approximately circular plasma cross sections and strongly elongated (elliptical) ones. Such calculations are of interest for constructing axisymmetric tokamak divertors, as well as for producing elongated cross-sections, which have been postulated to be stable for higher values of plasma pressure. The results presented here are restricted to the case of zero plasma pressure and a particular current distribution in order to reduce the number of free parameters and allow more detailed discussion of the dependence of the equilibrium configurations on the arrangement of the external conductors and the currents. (auth)

26374 THEORETICAL AND EXPERIMENTAL EVALUATION OF NUCLEAR DATA AND CALCULATION TECHNIQUES FOR

FUSION REACTOR BLANKET DESIGN. Freim, J. B. Austin, TX; Univ. of Texas (1972). 229p. University Microfilms Order No. 73-18,425.

Thesis (Ph. D.).

A calculational and experimental determination of the neutron spectrum in a graphite mock-up of a fusion reactor blanket was made. The calculation of the flux involved the use of ANISN, a discrete ordinates code, in slab and in sphere geometry and Battelle Monte Carlo (BMC). An investigation was performed to determine the variation of activities for selected reactions when the ANISN slab input parameters such as source geometry, quadrature order, and mesh size was varied. The activities did not change when the source geometry was varied, did increase for all reactions when a higher quadrature order was used, and decreased the thermal activities while increasing the threshold activities when the mesh size was decreased. The effect of two spectrum perturbations, target cooling water and neutrons from D–D reactions, was analyzed. The 250 mils of cooling water increased thermal activities and decreased threshold activities. The neutrons from a D–D reaction decrease the threshold activities by the percentage of D–D neutron contamination while the thermal activities remained unchanged. The experimental determination of saturated activities was made at the High Temperature Lattice Test Reactor (HTLTR) located at Battelle Northwest Laboratories. In the blanket model of pure graphite, fifteen different foils having nineteen separate reactions that covered the neutron spectrum from thermal to fast energies were irradiated. The source was 14.5-MeV neutrons resulting from accelerated deuterons that bombarded a tritium target. The counting data from the foils were reduced to saturated activities through the use of two computer programs. SATACT computed saturated activities from the Ge(Li) detector system data, and APDAC computed relative activities from the NaI(Tl) detector system data. A comparison of the experimental and calculated activities was made. For the threshold reactions ANISN slab was in agreement with the experimental data and BMC had the same shape of the experimental data. For the thermal reactions neither ANISN slab or ANISN sphere were in agreement with the experimental data although ANISN slab had the same general shape. (Diss. Abstr. Int., B)

26375 RUNAWAY-ELECTRON DRIFT SURFACES AND MAGNETIC SURFACES IN LT-3. Morton, A. H.; Strachan, J. D.; Vance, C. F. (Australian National Univ., Canberra). Nucl. Fusion; 13: No. 4, 631-633(Aug 1973).

Results are presented from current experiments on the small Canberra Tokamak which show the presence of magnetic surfaces and indicates their geometry. This information comes from observations of the quenching of high-energy electrons which occur naturally as runaways. It is shown that the drift surfaces of the runaway electrons and the magnetic surfaces lie so close together that the character of the magnetic surfaces can be described. (MOW)

Wave Phenomena

Refer also to abstracts 25637 and 26336.

26376 (AD-756477) NONLINEAR THEORY OF ELECTRON OSCILLATIONS OF A COLLISIONLESS PLASMA IN A UNIFORM MAGNETIC FIELD. Sen, H. K.; Prasad, B.; Bakski, P. M.; Kalman, G. (Air Force Cambridge Research Labs., L. G. Hanscom Field, Mass.). 5 Sep 1972. 51p. (AFCRL-72-526; AFCRL-PSRP-509). NTIS.

Possibility of excitation of finite-amplitude longitudinal waves in a collisionless and cold plasma in the presence of a uniform magnetic field is demonstrated. Such waves are found to be anharmonic in shape, in contrast to the usual harmonic, i.e., sinusoidal waves of the linear theory. These nonlinear plasma waves arise as a result of nonlinear motion and the dispersive nature of plasma media. The two competing processes, nonlinearity and dispersion in a moving plasma medium strike a balance to produce a quasi-steady state that can support finite-amplitude waves. These waves are associated with large-amplitude oscillating electric fields, which may be responsible for coherent radio-to-microwave radiation from coronal plasma and particle acceleration during solar flares. The estimate of sporadic electromagnetic and particulate radiation is important for application to the solar flare patrol and the Air Force Communications System. (auth)

26377 (AD-759789) LINEAR AND NONLINEAR TONKS–DATTNER RESONANCES IN LABORATORY AFTERGLOW PLASMAS. Rao, K. V. N. (Air Force Cambridge Research Labs., L. G. Hanscom Field, Mass.). 7 Feb 1973. 39p. (AFCRL-PSPR-533; AFCRL-TR-73-94). NTIS.

The electroacoustic resonances commonly known as Tonks–Dattner resonances were excited in neon, argon, xenon, and mercury afterglow plasmas using microwaves in the frequency range 2 to 4 GHz. The afterglow plasmas were produced by high-voltage dc pulses across electrodes in cylindrical discharge tubes located in S-band waveguides. Peak electron densities were measured utilizing the electro-acoustic resonances. These are compared with those measured simultaneously using the microwave cavity perturbation technique. The nonlinear interaction of the transverse electromagnetic waves with the inhomogeneous plasma is probed as the excitation signal strength is increased from microwatts to hundreds of milliwatts. The second harmonic amplitude of the signal emitted from the plasma column when excited at plasma resonance is probed as a function of the excitation field strength and also as the gas pressure is varied. (NTIS)

26378 (IPPCZ-153) PROPAGATION AND REFLECTION OF AN ELECTROMAGNETIC WAVE IN A HOT INHOMOGENEOUS PLASMA. Petrzilka, V. A.; Preinhaelter, J. (Ceskoslovenska Akademie Ved, Prague. Ustav Fyziky Plazmatu). Aug 1971. 13p. INIS.

Using the WKB method, the local dispersion equation of a right-hand circularly polarized wave and the expression for its electric field are derived, the wave having a frequency lower than the electron cyclotron frequency and propagating in a hot inhomogeneous plasma. The density gradient of a plasma is constant and parallel to an external magnetostatic field. The reflection coefficient of this wave is derived. (auth)

26379 THEORY OF PARAMETRIC EXCITATION OF ELECTROSTATIC SURFACE WAVES IN A PLASMA LAYER. Aliew, J. M. (Lebedev Inst. of Physics, Moscow); Gradow, O. M.; Suender, D. Beitr. Plasmaphys.; 12: No. 6, 361-372(1972). (In German).

Dispersion relations for electrostatic surface waves in a homogeneous plasma layer, which interacts with an external electric pumping field parallel to the boundaries, are derived in the framework of kinetic theory. Parametrically excited and purely growing instabilities are investigated. Electric-threshold fields and growth rates for the unstable surface modes are given. It can be shown that the minimum threshold for parametric excitation occurs for those modes that are symmetric about the midplane of the layer. (auth)

26380 OBSERVATION OF "SWITCH-ON" SHOCKS IN A MAGNETIZED PLASMA. Craig, A. D.; Paul, J. W. M. (Culham Lab., Abingdon, Eng.). J. Plasma Phys.; 9: No. 2, 161-186(Apr 1973).

In an experiment designed to produce shock waves propagating into a magnetized hydrogen plasma in directions parallel and almost parallel to the initial field, the "switch-on" shock was observed. A magnetic piston is produced by a fast-rising radial discharge between a short central and an annular outer electrode at one end of the chamber; the Lorentz force on the current sheet causes axial propagation, and under certain conditions a curved shock front propagates ahead of the piston. The Alfvén Mach number of the flow is varied by changing the axial field strength; at low Mach number a clearly separated curved shock front is found which passes through a point of parallel propagation. Magnetic- and electric-probe measurements at the point of parallel propagation show the presence of a "switch-on" shock. It is suggested that the "switch-on" and adjacent oblique shocks are matched together by an intermediate wave propagating behind the latter and merging with the former. (auth)

26381 WAVENUMBER SPACE ANALYSIS OF OSCILLATIONS IN WEAKLY NONUNIFORM MAGNETOPLASMAS. Brownell, J. H. (Stanford Univ., CA). J. Plasma Phys.; 9: No. 2, 275-293 (Apr 1973).

A differential equation in wavenumber space is used to find the electric field excited by an external source in a weakly nonuniform, low-β, neutral magnetoplasma slab (with B perpendicular to ∇n). Electrostatic waves which propagate across the magnetic field parallel to the density gradient are considered, and the impedance of a grid–plasma system is determined. The calculation is specialized to the case of a low density plasma with applied frequencies near the upper hybrid. (auth)

26382 THIN FILM REFLECTION PROPERTIES OF ISOTROPIC AND UNI-AXIAL PLASMA SLABS. Kalluri, D.; Prasad, R. C. (Birla Inst. of Tech., Mesra, India). Appl. Sci. Res. (The Hague); 27: No. 6, 415-424(Jun 1973).

The maxima and minima of the power reflection coefficient as a function of the wave frequency of an electromagnetic wave obliquely incident on isotropic and uni-axial plasma slabs are discussed. (auth)

26383 NONLINEAR PROPAGATION OF ELECTROMAGNETIC WAVES IN A WEAKLY IONIZED PLASMA. Liberman, M. A.;

Rakhimov, A. T. (Institute of Physical Problems, Academy of Sciences of the USSR, Moscow). Sov. Phys.–Tech. Phys. 17: No. 9, 1443-1446 (Mar 1973).

An electromagnetic wave in a weakly ionized plasma is investigated with respect to the propagation at a frequency below the effective collision frequency for electrons and neutrals. Expressions are obtained for the depth of penetration of the electromagnetic field into the plasma and for the impedance in the region in which the effect of the electromagnetic wave on ionization balance in the plasma is important. (auth)

26384 PROPAGATION OF A NONLINEAR WAVE IN A WEAKLY TURBULENT PLASMA. Dzhavakhishivili, D. I. (Tibilisi State University). Sov. Phys.–Tech. Phys. 17: No. 9, 1438-1442 (Mar 1973).

The propagation of nonlinear ion–acoustic waves in a weakly turbulent magnetoactive plasma is discussed. It is known that turbulence leads to an effective increase in the frequency of electron–ion collisions; these effective collisions influence the kinetic coefficients and the propagation of a shock wave in the turbulent plasma. When the dissipative terms are larger than the dispersive terms, an ordinary shock wave is obtained for which the thickness is determined by the energy density of the pulsating oscillation. The dependence of the width of the front on θ, the angle between the directions of the wave vector and the magnetic field, is studied. In the opposite limit, in which the dispersive effects are larger than the dissipative effects, an isolated wave (soliton) is obtained, the height and half–width of which also depend on the angle θ. When the dissipative effects are insufficiently large, the shock wave can have both oscillating and monotonic profiles. It is difficult to obtain a shock wave with a monotonic profile at large θ. (auth)

26385 PARAMETRIC RESONANCE IN AN INHOMOGENEOUS PLASMA. Aliev, Y. M.; Gradov, O. M.; Kirii, A. Y. (M. V. Lomonosov Moscow State University). Sov. Phys.–Tech. Phys. 17: No. 9, 1453-1457 (Mar 1973).

The inhomogeneity of a plasma affects the parametric instability by localizing the excited plasma and ion–acoustic oscillations. A density profile is considered which has a minimum in the middle of the layer and an abrupt drop near the plasma boundaries; in this case the ion–acoustic oscillations are localized in a region that is much larger than that for the plasma waves. In the case of parametric resonance at the plasma frequency ion–acoustic waves are generated only in the region in which the plasma waves are localized, where these are in spatial resonance with the ion–acoustic oscillations. The ratio of the threshold rf field in an inhomogeneous plasma to the corresponding threshold for a homogeneous plasma is equal to the square root of the ratio of the characteristic dimensions of the regions in which the ion–acoustic and the plasma oscillations are localized. The plasma inhomogeneity does not affect the threshold for the aperiodic instability, which can therefore be smaller than the corresponding threshold for a periodic instability. (auth)

26386 ELECTROSTATIC ION–CYCLOTRON PLASMA OSCILLATIONS. Kaladze, T. D.; Lominadze, D. G. (Physics Institute, Academy of Sciences of the Georgian SSR, Tbilisi). Sov. Phys.–Tech. Phys. 17: No. 9, 1597-1598 (Mar 1973).

The dispersion of the electrostatic ion-cyclotron oscillations in a homogeneous plasma was investigated. Relations between the first fifteen characteristic frequencies of the cyclotron oscillations and the wave vector were obtained for a number of values of the ratio of the ion temperature to the electron temperature by solving the dispersion equation numerically. (CES)

26387 INSTABILITY OF ION–ACOUSTIC SURFACE WAVES OF FINITE AMPLITUDE. Kondratenko, A. N.; Shaptala, V. G. (A. M., Gor'kii Khar'kov State University). Sov. Phys.–Tech. Phys. 17: No. 9, 1602-1603 (Mar 1973).

The amplitude of the ion-acoustic surface wave is found as a function of time on the basis of energy conservation. It is shown that the ion-acoustic surface wave is eventually completely converted into volume ion-acoustic waves. (CES)

26388 ROLE OF KORTEWEG–DE VRIES EQUATION IN PLASMA PHYSICS. Jeffrey, A. (Univ. of Newcastle-upon-Tyne, Eng.). Quart. J. Roy. Astron. Soc.; 14: No. 2, 183-189(Jun 1973).

The relevance of the Korteweg–de Vries equation to plasma physics only became apparent comparatively recently, mainly in connection with studies related to the problem of whether or not the so-called collision-free shock wave is possible. This aspect is reflected in the early work of Berezin & Karpman (Sov. Phys. JETP, 19: 1265-1271(1964)) on the nonlinear evolution of finite-amplitude disturbances in low-density plasmas and other dispersive media. A comprehensive review of the mathematical properties of weak nonlinear dispersive waves and of the KdV equation in relation to gravity waves, plasma waves, and lattice waves has been presented elsewhere (Jeffrey et al., SIAM Review, 14: 582-642(1972)). Here, the author draws attention to the body of existing work concerning this equation and to its physical interpretation and importance in the study of small but finite-amplitude waves in plasmas. In particular, comments are made on the role played by the KdV equation in the study of small but finite-amplitude magneto-acoustic waves, ion acoustic waves, and Alfvén waves in inhomogeneous plasmas. At the same time some comment is offered concerning the way in which the equation can be used to explain the persistence of some types of nonlinear wave phenomena under certain conditions and the generation of oscillations in others. (UK)

26389 COIL–EXCITED LOW–FREQUENCY WAVES IN A SINGLE–ENDED Q MACHINE. Sato, N.; Sugai, H.; Sasaki, A.; Hatakeyama, R. (Department of Electronic Engineering, Tohoku University, Sendai, Japan). Phys. Rev. Lett. 30: No. 15, 685-688 (9 Apr 1973).

Two modes were excited by applying oscillating currents to a small coil surrounding a plasma column in a single-ended Q machine. One of them had the same dispersion relation as grid-excited waves, beyond about half a wavelength from the exciting position. The other was an electrostatic ion cyclotron wave propagating along a magnetized plasma column. (auth)

26390 COUPLING BETWEEN ELECTROSTATIC ION CYCLOTRON WAVES AND ION ACOUSTIC WAVES. Ohnuma, T.; Miyake, S.; Watanabe, T.; Watari, T.; Sato, T. (Institute of Plasma Physics, Nagoya University, Nagoya, Japan). Phys. Rev. Lett. 30: No. 12, 535-537 (19 Mar 1973).

We have observed the linear coupling between an electrostatic ion cyclotron wave and an ion acoustic wave near the second-harmonic ion cyclotron frequency for propagation of an electrostatic ion wave along a magnetic field, where the wave number perpendicular to the magnetic field $k_\perp$ exists. (auth)

26391 SATURATION AMPLITUDE OF NONLINEARLY EXCITED PLASMA WAVES. Lee, P. S.; Lee, Y. C.; Chang, C. T.; Chuu, D. S. (Department of Physics and Astronomy, State University of New York at Buffalo, Buffalo, New York 14214). Phys. Rev. Lett. 30: No. 12, 538-540 (19 Mar 1973).

The saturation amplitude of a nonlinearly excited plasma oscillation is calculated, taking into account both the frequency–mismatch effect due to relativistic correction and the effect of collision damping. It is explicitly shown, even in cases where the collision frequency ν may be considered extremely small, how the inclusion of $\nu=0^+$ leads to a qualitative change in the asymptotic behavior of the system. (auth)

26392 LABORATORY OBSERVATION OF SLOW–MODE SHOCK WAVES. Craig, A. D.; Paul, J. W. M. (United Kingdom Atomic Energy Authority, Research Group, Culham Laboratory, Abingdon, Berkshire, England). Phys. Rev. Lett. 30: No. 15, 681-684 (9 Apr 1973).

We have identified a slow–mode shock wave in a laboratory experiment. We also present a model of the novel method of launching the shock. (auth)

26393 LARGE-AMPLITUDE ELECTROMAGNETIC WAVES IN HOT RELATIVISTIC PLASMAS. Schindler, K.; Janicke, L. (Ruhr Univ., Bochum, Ger.). Phys. Lett., A; 45A: No. 2, 91-92 (10 Sep 1973).

In view of possible astrophysical applications, the theory of large-amplitude undamped electromagnetic waves is generalized to include thermal effects. Exact solutions of the nonlinear relativistic Vlasov equations are constructed. Sufficiently large velocity spreads lead to large reductions in the cutoff frequency. (auth)

26394 TEMPORAL LINEAR BERNSTEIN ECHOES. Navet, M.; Felix, M. R. (Univ., Orleans, France). Phys. Lett., A; 45A: No. 1, 55-56(27 Aug 1973).

The appearance of a magnetic field perpendicular to the direction of propagation discretizes the continuum spectrum of electrostatic oscillations. For weak magnetic field B, this discretization gives linear temporal echoes of shape independent of B and separated by a cyclotron period. (auth)

26395 NONLINEAR-WAVE-THEORY ASPECTS OF CURRENTS IN A PLASMA. Sharma, S. C. (Princeton Univ., NJ). Contract AT(11-1)-3073. Phys. Lett., A; 45A: No. 1, 61-62 (27 Aug 1973).

A nonstationary characteristic of currents in a plasma structure (a cartesian (Ex) or a radial cylindrical (Fρ) or a radial spherical (Er)) in nonlinear wave theory is discussed. (auth)

26396 OBSERVATION OF EXTRAORDINARY WAVE PROPAGATION NEAR THE LOWER-HYBRID-RESONANCE FREQUENCY. Moresco, M. (CEN, Grenoble, France). Phys. Lett., A; 45A: No. 1, 65-67(27 Aug 1973).

Measurements of $k_\perp$ for an extraordinary wave near the lower hybrid frequency were carried out by means of propagation between two dipole antennas into a plasma column. Resonance-like behavior was observed when plasma parameters and frequency fulfil the condition $\omega \approx \omega_{LH}$ (auth)

26397 TRAPPED-PARTICLE SCATTERING BY ELECTROSTATIC TURBULENCE IN TOROIDAL PLASMAS. Dobrowolny, M. (European Space Research Inst., Frascati, Italy); Orefice, A.; Pozzoli, R. Nucl. Fusion; 13: No. 4, 485-496(Aug 1973).

Possible effects of turbulent electrostatic waves on trapped-particle motions in low-β toroidal plasmas are investigated. A mechanism of resonance between the frequencies of the waves in the turbulent spectrum and the harmonics of the particle bounce frequency in the magnetic wells is found to provide stochastic trapped-particle diffusion. The effectiveness of this diffusive process in scattering trapped particles out of the trapping cone in velocity space is investigated in detail as functions of the wave features and of the particle parallel energy for the cases of ion sound waves and of different types of drift waves. The conclusions are that an electrostatic turbulence of a relatively low level, with typical frequencies higher than the bounce frequency and wavelengths shorter than the connection length, can be effective in scattering trapped electrons out of the trapping cone in typical times longer than the bouncing time but still shorter than collisional times. On the other hand, similar effects cannot be obtained easily for the ions, owing to their greater inertia. (auth)

26398 LINEAR SIDEBANDS. Morales, G. J. San Diego, CA; Univ. of California (1973). 137p. University Microfilms Order No. 73-19,780.

Thesis (Ph. D.).

The existence of a new mechanism by which waves at nearby frequencies can be excited when a small amplitude, monochromatic, electron plasma wave is launched in a collisionless plasma is shown. The amplitude of these excited sidebands depends linearly on the amplitude of the launched wave, hence they have been named linear sidebands. A striking feature of linear sidebands is that their amplitude exhibits large spatial oscillations, while the amplitude of the wave exciting them damps monotonically according to the linear theory of Landau. (MOW)

26399 NONLINEAR INTERACTIONS OF LONGITUDINAL AND TRANSVERSE OSCILLATIONS IN THE HIGH-FREQUENCY HYBRID RESONANCE REGION. Demchenko, V. V.; El-Naggar, I. A. (Atomic Energy Authority, Cairo). Nucl. Fusion; 13: No. 4, 634-635(Aug 1973).

It is shown that inhomogeneity of plasma density gives rise to nonlinear interaction of longitudinal and transverse oscillations of the electrons. Strongly nonlinear oscillations are considered. Analytical expressions are given. (MOW)

PHYSICS (RADIATION AND SHIELDING)

Radiation Physics

Refer also to abstracts 25215, 25228, 25230, 25246, 25330, and 25667.

26400 INFLUENCE OF CHANNELLING ON SECONDARY ION EMISSION YIELDS. Bernheim, M. (Paris Univ., Orsay, France). Radiat. Eff.; 18: No. 3-4, 231-234(1973).

The sputtering yield of a single crystal changes very sharply with the relative orientation of the primary beam and the lattice. This is related to the channeling effect of the primary ion through the lattice. The secondary ion-emission yield varies when a monocrystallite target is rotated around an axis normal to the surface and the incidence angle of the primary beam is kept constant at about 60°. The intensities of different types of ions, monoatomic ions of 0 to 15 eV and fast ions 100, 200, and 500 eV, multicharged and polyatomic species, were recorded as a function of the target orientation. Different ways of reducing the variation of penetrations of the primary ion into the target are investigated, to suppress the differences of sputtering in order to be able to analyze thin polycrystalline targets by making use of the secondary ion emission. (auth)

26401 DECHANNELING OF 5-MeV PROTONS FROM PLANAR CHANNELS IN SILICON AND ITS TEMPERATURE DEPENDENCE. Altman, M. R. (Rutgers–the State Univ., New Brunswick, NJ). Feldman, L. C.; Gibson, W. M. Radiat. Eff.; 18: No. 3-4, 171-180(1973).

The dechanneling properties of 5-MeV protons in {110} planes in silicon were observed. From measurements of the spectra of particles transmitted through a 60-μ-thick crystal, the half-thickness ($x_{\frac{1}{2}}$) for dechanneling is deduced for crystal temperatures between room temperature and 600°C. An absence of a significant temperature dependence of multiple scattering in the plane is observed and suggests that the multiple scattering is predominantly electronic. Calculations of the dechanneling length, $x_{\frac{1}{2}}$ as a function of temperature, using the Monte-Carlo critical angle results of Barrett (Phys. Rev.; 3: 1527(1971)), are found to agree very well with the experimental results. Also, the energy loss rate of well-channeled protons is observed to be independent of temperature up to 600°C. This result correlates well with previous observations of the temperature dependence of channeled-particle ranges. (auth)

26402 MEASUREMENT OF THE BACKSCATTERING OF FISSION FRAGMENTS FROM THIN METAL FILMS. Vetter, A.; Fiedler, G.; Guettner, K.; Schmidt, H. (Univ., Giessen, Ger.). Radiat. Eff.; 18: No. 3-4, 143-147(1973).

The backscattering of ^{235}U fission fragments from thin polycrystalline gold and lead films was studied by transmission electron microscopy. This method gives information about the total reflection rate, the distribution of the reflection angles, and the penetration depth for low angles of incidence. Satisfactory agreement was obtained between Monte Carlo calculations and the experimental results. (auth)

26403 MATHEMATICAL MODEL FOR RADIATION FIELDS OF TELECOBALT TREATMENT UNITS WITH SPECIAL REFERENCE TO THE ISODOSES OF ROCUS. Patomaeki, L. (University Central Hospital, Helsinki). Acta Radiol., Suppl.; No. 309, 1-82(1971).

A new mathematical model for approximation of the dose distribution in the beam of a Rocus cobalt unit (Techsnabexport, Leningrad) is presented. It is intended for dose planning calculations by computers. The model is expected to be suitable for approximating beams of any cobalt unit with only slight changes in parameters. In the model the relative dose rate is the product of the depth dose function and the profile function. The former is further a product of the absorption factor (or tissue-air-ratio) and the inverse square factor divided by the backscatter factor. The absorption factor has been determined on the basis of the depth dose values in the literature. Measurements indicate that these are consistent with the depth dose values of Rocus for source to skin distances of 50 to 80 cm. This factor has been approximated by a polynomial of z (the depth in tissue) of second degree, the coefficients of which have further been approximated by a polynomial of the second degree of the field side s of a square field. The profile function is the sum of two power functions. It is expected to be suitable for approximation of profiles of roentgen beams, linear accelerator beams and betatron beams (roentgen rays) with suitable values of the parameters. With these it may even exceed the usefulness it has already shown in describing the profiles of a cobalt unit. (SW)

26404 ENERGY LOSSES OF FAST ELECTRONS DUE TO THE CREATION OF EXCITONS IN MAGNETIC FIELDS. Glauberman, A. E.; Pundyk, A. V. (I. I. Mechnikov Odessa State University). Sov. Phys.–Solid State 14: No. 10, 2603-2604 (Apr 1973).

A study is made of the energy losses of fast electrons due to the creation of bound and free electron–hole pairs in strong quantizing magnetic fields. It is found that the dependences of the creation probabilities of large- and small-radius excitons on the field strength have different forms. (auth)

26405 RECOIL FRACTION TECHNIQUE FOR MEASURING NUCLEAR AND ELECTRONIC STOPPING POWERS. Shnidman, R.; Tapphorn, R. M. (Ballistic Research Laboratories, Aberdeen Proving Ground, Maryland, 21005); Geller, K. N. Appl. Phys. Lett. 22: No. 10, 551-553 (15 May 1973).

A new technique for measuring nuclear and electronic stopping powers of heavy ions in solids is described. The method does not require direct acceleration of the heavy ions nor does it require ultrathin uniform film targets. The method should be useful from the MeV region down to tens of keV. Results for carbon ions in carbon from 0.5 to 1.4 MeV are presented. (auth)

26406 ENERGY-LOSS MEASUREMENTS OF ^{4}HE IONS IN HEAVY METALS. Chu, W. K.; Ziegler, J. F. (IBM Research, Yorktown Heights, New York, 10598); Mitchell, I. V.; Mackintosh, W. D. Appl. Phys. Lett. 22: No. 9, 437-439 (1 May 1973).

Energy–loss measurements have been for 2.0–MeV ^{4}He ions in 20 targets. The energy–loss cross sections were determined by analysis of thick–target backscattering yields. Eight of the targets have been previously measured and support the accuracy of the present measurement. Twelve new heavy–metal targets are evaluated: Pb, Au, Pt, Ir, W, Ta, Hf, Gd, Te, Sb, Mo, and Ge. By using the Lindhard–Winther formalism with Hartree–Fock–Slater atomic charge distributions, the stopping cross sections for these metals are predicted down to 1.4 MeV. (auth)

26407 MEASUREMENTS OF RANGE IN MATTER FOR RELATIVISTIC HEAVY IONS. Schimmerling, W.; Vosburgh, K. G. (Princeton Particle Accelerator, P. O. Box 682, Princeton, New Jersey 08540); Todd, P. W. Phys. Rev. B 7: No. 7, 2895-2899 (1 Apr 1973).

The range of fully stripped, relativistic nitrogen, neon, and argon nuclei have been measured in polyethylene, polymethylmethacrylate (PMMA), aluminum, copper, and lead. The heavy ions were produced by the Princeton Particle Accelerator and had energies ranging up to 284 MeV/amu. The measured results are compared with calculations derived from similar data for protons and good agreement is found at the 1–3% level. (auth)

26408 THEORY OF SCATTERING YIELD IN CHANNELING. Ohtsuki, Y. H. (Waseda Univ., Tokyo). Phys. Status Solidi (b); 59: No. 1, 303-307(1 Sep 1973).

Making use of the nonlocal potential due to inelastic scattering, an expression for the transition probability of inelastic scattering in channeling is introduced. The theory of backscattering yield oscillation is studied as a demonstration. Expressions for the blocking pattern and the star pattern are also presented in terms of the transition probability in channeling. (auth)

26409 MEASUREMENTS OF GAMMA-RAY ATTENUATION COEFFICIENTS. Goswami, B.; Chaudhuri, N. (Department of Physics, University of North Bengal, India). Phys. Rev. A 7: No. 6, 1912-1916 (June 1973).

Measurements have been made to determine γ–ray attenuation coefficients very accurately by using an extremely–narrow–collimated–beam transmission method which effectively excluded corrections due to small–angle and multiple scattering of photons. The measured mass attenuation coefficients with maximum errors less than 3% for 34 elements in the range from hydrogen to lead are given. (auth)

26410 ELECTRONIC STOPPING CROSS SECTIONS. Green, A. E. S.; Hill, R. K. (Department of Physics, University of Florida, Gainesville, Florida 32601). Phys. Rev. A 7: No. 6, 2219-2222 (June 1973).

We examine a three–parameter formula for the electronic stopping cross section at nonrelativistic velocities of Brice based upon the Firsov formalism. We show that it is substantially a special case of a simple formula applied earlier by Green and Peterson, and that the work of Brice provides an approximate rule relating two of their four parameters. (auth)

26411 EXTERNAL BREMSSTRAHLUNG DUE TO ^{90}Sr–^{90}Y BETA PARTICLES. Mudhole, T. S. (Karnatak Univ., Dharwar, India). Indian J. Pure Appl. Phys.; 11: No. 3, 199-205(Mar 1973).

The external bremsstrahlung (EB) emitted when ^{90}Sr–^{90}Y beta particles are incident on targets of Cu, Cd, and Pb of different thicknesses was measured with an NaI(Tl) scintillation spectrometer. The EB intensity first builds up to a maximum value for target thickness of about 0.4 times the range of beta particles, and this increase of EB intensity is not linear. This nonlinear increase is shown to follow an empirical relation of the type $te^{-\Sigma_B t}$ (where Σ_B is found to be independent of the atomic number of the target and also the photon energy), t being the thickness of the target in mg/cm^2. By using this empirical relation, the EB intensity per atom of the target, in arbitrary units, in the limit of the target thickness tending to zero, is determined by a method of linear extrapolation. It is empirically shown that this intensity is free from the effects of slowing-down of beta particles and attenuation of the photons in the target. The measured extrapolated EB spectrum is compared with that deduced from the Bethe–Heitler theory. The experimental values are 10% higher than the theoretical values at 1.0 MeV and 250% higher at 1.8 MeV for Z = 1. Further, it is found that the variation of the EB intensity and the variation of the fraction of the incident beta particles that are completely absorbed within the target foil have the same dependence on the thickness of the target foil. Both these variations follow an empirical relation of the type $te^{-\Sigma t}$, where Σ in both cases is the same and independent of the atomic number of the target. (8 figures) (auth)

26412 INTERNAL DOSE CALCULATION ACCORDING TO THE EXTENDED CONCEPT OF ABSORBED FRACTIONS: EXACT AND APPROXIMATE SOLUTION. Roedler, H. D.; Kaul, A. (Freie Univ., Berlin). Atomkernenergie; 21: No. 4, 249-253 (1973). (In German).

From Joint meeting 1972 of the Deutsche Gesellschaft fuer Biophysik e.V. and the Deutsche Gesellschaft fuer Medizinische Physik e.V.; Erlangen, Germany (4 Oct 1972).

For internal dose calculations a formally exact model was developed based upon the concept of absorbed fractions. As the practical application of this dose model is quite complicated, the model was completed by an approximate solution, which substitutes the absorbed fractions of the remaining body by those of the total body. Criteria are discussed, which define the applicability of the approximate solution. (GE)

26413 ENERGY DISTRIBUTION ABOUT THE CROSS SECTION OF A TRACK OF CHARGED PARTICLES HAVING THE SAME LINEAR TRANSFER OF ENERGY. Kalugina, I. K.; Keipim-Markus, I. B.; Savinskii, A. K.; Filyushkin, I V. At. Energ. (USSR); 34: No. 4, 298-299(Apr 1973). (In Russian).

A radial distribution of energy was calculated for the cross sections of tracks of three particles with identical linear energy transfer in water L_{00} = 90 keV/μ: 60 keV protons, 140 KeV protons, and 4.5 MeV α-particles. The calculations were also extended to the dimensions of typical biological structures: the radius of a nitrogen base or nucleotide of DNA, the radius of a small virus, and that of a large virus. (KSW).

26414 AVERAGE ENERGY PER ION PAIR, W, FOR HYDROGEN AND OXYGEN IONS IN A TISSUE EQUIVALENT GAS. Leonard, B. E. (Inst. for Resource Management, Inc., Bethesda, MD); Boring, J. W. Radiat. Res.; 55: No. 1, 1-9(Jul 1973).

Measurements are reported for the value of $\overline{W}$ (the average energy required to form an ion pair) for hydrogen and oxygen ions in the Rossi–Failla, tissue-equivalent gas mixture. The University of Virginia kevatron linear dc ion accelerator was used to produce the monoenergetic ions. For the six different incident monoenergetic hydrogen ions employed with kinetic energies ranging from 3.72 to 48.24 keV per atom, the values for $\overline{W}$ ranged from 46.5 to 30.4 eV per ion pair. For the incident monoenergetic oxygen ions employed with kinetic energies of 24.52 and 49.05 keV per atom, values for $\overline{W}$ of 66.0 and 52.2 eV per ion pair, respectively, were obtained. Thus, a general increase in $\overline{W}$ with decreased kinetic energy was observed. Comparisons were made with computed $\overline{W}$ values which are predicted from stopping power theory. (auth)

Shielding Calculations and Experiments

Refer also to abstracts 26517 and 26520.

26415 YIELD OF CAPTURE GAMMA RAYS FROM A LAYER OF IRON STRUCK OBLIQUELY BY NEUTRONS. Degtyarev, S. F.; Repin, N. N.; Sakovich, V. A.; Sakharov, V. M.; Suvorov, A. P.; Tarasov, V. V. At. Energ. (USSR); 33: No. 1, 575(Jul 1972). (In Russian).

This paper was summarized as paper No. 593/6673 with full copy held by TIC.

The angular distribution of the flux of gamma rays beyond the iron layer in a shielding barrier was calculated for several angles and thicknesses by integrating with respect to the depth of the shielding the angular distributions of gamma rays from a plane isotropic source of neutrons beyond the shielding barrier. Measurements of the spectral–angular distribution of capture gammas beyond a barrier of Fe, boron carbide, and polyethylene were carried out for an iron thickness of 28 cm. When the angle of incidence of the neutrons was increased from 0 to 60°, the total capture gamma-ray energy flux was found to be reduced by a factor of about 1.5. The angular distribution of the energy flux beyond the Fe layer consisted mainly of unscattered gamma rays, and was practically isotropic in the observed range of neutron angles of incidence. It was also found that the shape of the capture gamma spectra was almost completely independent of the angle of incidence of the neutrons and of the angle at which the gammas left the shielding barrier. (4 figures) (RWR)

PHYSICS (THEORETICAL)

General

Refer also to abstracts 26616, 26884, and 26914.

26416 LAGRANGIAN QUANTUM THEORY. II. Several Degrees of Freedom. Bloore, F. J.; Routh, L. (Univ. of Liverpool). Nucl. Phys.; B59: No. 2, 348-364(1973).

A consistent Lagrangian quantum theory is presented for n degrees of freedom using Frechet calculus, by characterizing the variations for which the action is stationary. If a set of algebraic quantities q^i, $\dot{q}^i$, $i = 1, \ldots, n$ are such that the q's commute, $[q^i, \dot{q}^j]$ is given and independent of $\dot{q}$ and $[\dot{q}^i, \dot{q}^j]$ is given and linear in $\dot{q}$ then the Hamiltonian $H(q, \dot{q})$ satisfying $\dot{q}^i = i[H, q^i]$ is prescribed up to an additive function V(q). The commutators $[q^i, \dot{q}^i]$ and $[\dot{q}^i, \dot{q}^j]$ determine a metric tensor g and a closed two-form K^R respectively. If V(q) is given, then there is a Lagrangian L, unique up to a guage and a multiplicative constant λ, having an action which is stationary with respect to n linearly independent variations of the form $\delta q(t) = l(t)\alpha(q)$. The vector fields $\alpha(q)$ in these variations must be killing. All killing variations α and no others leave the action stationary. A vector $\alpha(q)$ is called generated if it is killing for g and if $\alpha \cdot K^R$ is conservative. Noether's theorem, which relates symmetries of the Lagrangian to conserved quantities, holds since all variations α which leave the Lagrangian invariant can be shown to be generated. If a vector α is generated then there is a gauge in which its generator is the Frechet derivative $(\partial L/\partial \dot{q}^i, \alpha^i)$. (auth)

26417 ELECTRODYNAMICS, GRAVITATION, AND SPIN. Israel, W. (Univ. of Alberta, Edmonton). Lett. Nuovo Cim.; 7: No. 16, 860-864(18 Aug 1973).

A novel approach is used to examine how Maxwell's and Einstein's field equations have to be formulated in the presence of a medium whose particles have internal spin. The approach has the distinct advantage that various formal entities (e.g., canonical and symmetrized energy-momentum tensors) acquire a direct operational significance in terms of a concrete microscopic picture. (LBS)

26418 INVARIANCE ALGEBRAS AND INTERACTIONS IN NONRELATIVISTIC QUANTUM MECHANICS. Burdet, G.; Perrin, M.; Sorba, P. (CNRS, Marseille). Lett. Nuovo Cim.; 7: No. 16, 855-859(18 Aug 1973).

A method using the notions of derivation algebra and split extension is used to extend the extended Galilean algebra $\tilde{g}'$ by a $SU_{1,1}$ algebra and to construct the semi-direct sum $\tilde{g}' \square SU_{1,1}$ isomorphic to the extended Schroedinger algebra. It is shown that to each one-dimensional nonconjugate subalgebra of the simple Lie algebra $SU_{1,1}$ can be associated a class of Hamiltonians. (LBS)

26419 POSSIBLE STRENGTHENING OF THE INTERPRETATIVE RULES OF QUANTUM MECHANICS. Benioff, P. (Chemistry Division, Argonne National Laboratory, Argonne, Illinois 60439). Phys. Rev. D 7: No. 12, 3603-3609 (15 June 1973).

The usual interpretative rules of quantum mechanics are presented and are shown to be too weak. The reason is that they do not include the intuitive requirement of randomness of the outcome sequence obtained from an infinite repetition of measuring an observable on a state. A strengthening of the rules is proposed which includes, in essence, a precise definition of randomness. The resultant rule is seen to be intuitively more satisfying than the usual rules and to include the expectation value rule and to include essentially all of the spectrum rules of the usual rules. It also suggests that the relationship between the foundations of mathematics and quantum mechanics may be quite deep and complex. (auth)

26420 DISCRETE SPECTRUM OF THE HAMILTONIAN OF THE QUANTUM N-PARTICLE SYSTEM. Antonets, M. A.; Zhislin, G. M.; Shereshevskii, I. A. (Scientific-Research Radiophysics Inst., Gorky, USSR). Teor. Mat. Fiz.; 16: No. 2, 235-246(Aug 1973). (In Russian).

Sufficient conditions of the finiteness were obtained for the discrete spectrum of the energy operators of N-particle system in the space of functions with given permutation and rotation symmetry properties. It is shown that at the same conditions the lower bound of the continuous spectrum cannot be the eigenvalue of the infinite multiplicity. For the application of the main theorem the dependence of the Shrödinger operator eigenvalue on the coupling constant is investigated. (auth)

26421 SCALING LAWS AND UNIVERSALITY: OR STATISTICAL MECHANICS IS NOT DEAD. Stanley, H. E. (Massachusetts Inst. of Tech., Cambridge). pp 225-267 of Statistical Mechanics and Field Theory. Sen, R. N. (ed.). New York; John Wiley and Sons, Inc. (1972).

An introduction for the nonspecialist to some of the current problems of phase transitions and critical phenomena is presented. Then from a simple and unified point of view the scaling law hypotheses for thermodynamic functions, static correlation functions, and dynamic correlation functions is developed. In particular, the relation between homogeneity assumptions and "scaling functions" is clarified, and it is shown how new experimental tests of the scaling hypotheses might be carried out. A simple geometric interpretation of the scaling hypothesis is discussed, and it is shown how this has led to the recent calculation of the thermodynamic scaling functions. Further it is shown how the original two-exponent relations (such as $d\nu = 2 - \alpha$) acquire correction terms that turn them into thermodynamic function scaling laws (such as $\alpha + 2\beta + \gamma = 2$). The universality hypothesis is introduced, and recent calculations supporting its validity are discussed. The question of how critical-point exponents vary with D and d is discussed, where D and d denote the spin space and lattice dimensionality, respectively. Finally, a brief introduction to a purely phenomenological "dynamic cluster approximation" is presented. (auth)

Quantum Field Theories

Refer also to abstracts 25812, 25898, 25994, 26014, 26018, and 26468.

26422 SURVEY OF THE PRESENT STATUS OF NEOCLASSICAL RADIATION THEORY. Jaynes, E. T. (Washington Univ., St. Louis). pp 35-81 of Coherence and Quantum Optics. Mandel, L. (ed.). New York; Plenum Publishing Corp. (1973).

From 3rd Rochester conference on coherence and quantum optics; Rochester, NY (21 Jun 1972).

The various disturbing features of quantum electrodynamics which give rise to mathematical or conceptual difficulties are examined. It is inquired whether present empirical evidence demands their presence, and the consequences of modified theories in which these features are removed are explored. Semiclassical and neoclassical theory, spontaneous emission, and field fluctuations are covered. (JFP)

26423 TIME DELAY STATISTICS OF PHOTOELECTRIC EMISSIONS: AN EXPERIMENTAL TEST OF CLASSICAL RADIATION THEORY. Davis, W.; Mandel, L. (Univ. of Rochester, NY). pp 113-119 of Coherence and Quantum Optics. Mandel, L. (ed.). New York; Plenum Publishing Corp. (1973).

From 3rd Rochester conference on coherence and quantum optics; Rochester, NY (21 Jun 1972).

Since the photoelectric effect is taken to provide evidence for the quantum nature of electromagnetic radiation, the statistics of photoelectric emission are studied under conditions in which there is very high discrimination between the on and off phases of the light beam and at various times following the turn-on before, at, and after the critical accumulation time. It is found that the probability distribution is nearly Poissonian and there is no evidence of any variation. These results are clearly in agreement with the predictions of quantum electrodynamics and the semiclassical equation and show no evidence for the existence of any critical energy accumulation time. (JFP)

26424 DEBYE REPRESENTATION AND MULTIPOLE EXPANSION OF THE QUANTIZED FREE ELECTROMAGNETIC FIELD. Devaney, A. J. (Univ. of Rochester, NY). pp 241-257 of Coherence and Quantum Optics. Mandel, L. (ed.). New York; Plenum Publishing Corp. (1973).

From 3rd Rochester conference on coherence and quantum optics; Rochester, NY (21 Jun 1972).

A procedure is developed for obtaining the multipole expansion for the quantized electromagnetic field complete with the commutation relations for the multipole moment operators from the plane-wave representation for this field. Also the closely related Debye representation for the quantized field is derived, and the commutation relations for the Debye potential operators are determined. (JFP)

26425 FINITE QUANTUM AND CLASSICAL ELECTRODYNAMICS. Sudarshan, E. C. G. (Univ. of Texas, Austin). pp 289-299 of Coherence and Quantum Optics. Mandel, L. (ed.). New York; Plenum Publishing Corp. (1973).

From 3rd Rochester conference on coherence and quantum optics; Rochester, NY (21 Jun 1972).

A continuing investigation of relativistic finite quantum electrodynamics which is free from mathematical absurdities, in agreement with physical results, and is conceptually satisfactory is reported. (JFP)

26426 MODE ANALYSIS AND MODE COUPLING OF ELECTROMAGNETIC FIELDS IN SPATIALLY DISPERSIVE MEDIA. Pattanayak, D. N. (Univ. of Rochester, NY). pp 359-367 of Coherence and Quantum Optics. Mandel, L. (ed.). New York; Plenum Publishing Corp. (1973).

From 3rd Rochester conference on coherence and quantum optics; Rochester, NY (21 Jun 1972).

A self-consistent formulation of electrodynamics of spatially dispersive media is presented. It is shown that the essentials are contained in the macroscopic Maxwell equations together with the constitutive relations. (JFP)

26427 RESONANCE FLUORESCENCE LINESHAPES WITH INTENSE APPLIED FIELDS. Stroud, C. R. Jr. (Univ. of Rochester, NY). pp 537-546 of Coherence and Quantum Optics. Mandel, L. (ed.). New York; Plenum Publishing Corp. (1973).

From 3rd Rochester conference on coherence and quantum optics; Rochester, NY (21 Jun 1972).

The dynamic problem of resonance fluorescence is carried through as carefully as possible including radiative frequency shifts in order to test quantum electrodynamics. The treatment shows the limited range of validity of some of the commonly used approximations. (JFP)

26428 QUANTUM ELECTRODYNAMIC INVESTIGATION OF THE JAYNES-CRISP-STROUD APPROACH TO SPONTANEOUS EMISSION. Ackerhalt, J. R. (Univ. of Rochester, NY); Eberly, J. H.; Knight, P. L. pp 635-644 of Coherence and Quantum Optics. Mandel, L. (ed.). New York; Plenum Publishing Corp. (1973).

From 3rd Rochester conference on coherence and quantum optics; Rochester, NY (21 Jun 1972).

It is shown that Jaynes program to obtain atomic level shifts and widths by integrating directly the semiclassical equations of motion without resorting to perturbation theory may be taken over to quantum electrodynamics fairly simply. (JFP)

26429 DOUBLE WILSON EXPANSIONS OF PRODUCTS OF THREE SPINOR OPERATORS. Duerr, H. P. (Max-Planck-Institut fuer Physik und Astrophysik, Munich). Nuovo Cim.; 16A: No. 3, 411-422(1 Aug 1973).

An explicit evaluation of the generator condition for a current constructed as the Wilson finite part of a bilinear spinor operator product involves a double Wilson expansion in two different coordinate combinations. It is shown that in a gauge and scale invariant Weyl theory for a subcanonical spinor field of dimension $\frac{1}{2}$ the Wilson expansions can be explicitly constructed. No logarithmic-type modifications are necessary. The "dual" character of the expansions arises essentially from an exponentiation of logarithmic terms which is enforced by the gauge exponential. The nonlinear field equation arises naturally as a consistency condition. Explicit solutions for the generators in terms of the spinor field can be given. In the present framework these solutions are still not unique. (auth)

26430 WILSON OPERATOR PRODUCTS IN NONLINEARLY REALIZED THEORIES. Isham, C. J. (Imperial Coll. of Science and Tech., London); Salam, A.; Strathdee, J. Lett. Nuovo Cim.; 7: No. 17, 902-904(25 Aug 1973).

A conjectured Wilson operator-product ansatz is presented for localizable nonlinearly realized field theories which contain a dimensional parameter (the minor coupling constant). Self-interacting nonlinear theories and matter Lagrangians are considered. (JFP)

26431 POSITIVITY OF THE SCHWINGER TERM. Ezawa, Z. F. (Tokyo Univ.). Lett. Nuovo Cim.; 7: No. 17, 941-944 (25 Aug 1973).

It is proven that the Schwinger term is positive definite in the forward direction using a representation for the boson field interacting with the electromagnetic field. (JFP)

26432 INTEGRATION OF CLASSICAL NONLINEAR RELATIVISTIC WAVE EQUATIONS BY THE METHOD OF LIE SERIES. Raczka, R. (Inst. of Nuclear Research, Warsaw). Acta Phys. Pol.; B4: No. 4, 501-520(1973).

The method of Lie series is applied for the construction of local solutions of classical nonlinear relativistic wave equations. Next the explicit form of solutions is given for the classical massive Thirring equation, nonlinear Heisenberg equation, and the nonlinear equation in $\lambda\Phi^4$ theory. (auth)

26433 COHERENCE AND QUANTUM OPTICS. Proceedings of the Third Rochester Conference, June 21-23, 1972. Mandel, L.; Wolf, E. (eds.). New York; Plenum Publishing Corporation (1973). 925p. $39.50.

The conference contained 71 papers. Separate abstracts were prepared for 11 papers. The remaining papers were outside the subject scope of NSA. (JFP)

For abstracts of individual papers see: 25641, 25712, 25818, 26029, and 26422-26428.

26434 EFFECTIVE WEAK-INTERACTION CUTOFF OF ELECTROMAGNETIC RADIATIVE CORRECTIONS IN UNIFIED GAUGE THEORIES. Mohapatra, R. N.; Vinciarelli, P. (Department of Physics and Astronomy, University of Maryland, College Park, Maryland, 20742). Phys. Rev. Lett. 30: No. 17, 804-807 (23 Apr 1973).

We study the isospin-changing component of the total second-order radiative-correction operator in a special class of unified gauge theories, with strong interactions taken into account to all orders, and show that the contribution of the weak interactions amounts only to providing an effective cutoff to the electromagnetic contribution. (auth)

26435 FINE STRUCTURE AND PERIHELION ADVANCE. Fronsdal, C.; Huff, R. W. (Department of Physics, University of California, Los Angeles, California 90024). Phys. Rev. D 7: No. 12, 3609-3616 (15 June 1973).

The evaluation of field-theoretical corrections to the properties of bound states can be greatly simplified by basing it on our relativistic Lippmann-Schwinger equation rather than the Bethe-Salpeter on Schrödinger equations. We have evaluated the fine structure to order α^4 for a system of two scalar particles bound by the potential that arises from exchanging massless quanta of spin 0, 1, or 2. In each case fine structure is clearly related to seagull and/or graviton self-interaction diagrams, while neither the simple exchange diagram nor the box diagrams make any contribution. The simplification with respect to earlier calculations is particularly striking in the case of gravity. Also presented here is a calculation of the advance of the perihelion of Mercury within the framework of a recently developed classical-relativistic mechanics of two interacting point particles. The calculation is explicitly covariant. (auth)

26436 STUDY OF THE RENORMALIZATION GROUP FOR SMALL COUPLING CONSTANTS. Zee, A. (The Rockefeller University, New York, New York 10021). Phys. Rev. D 7: No. 12, 3630-3636 (15 June 1973).

A renormalizable quantum field theory is said to be stagnant if it is asymptotically free. We study the renormalization group for small coupling constants. In particular the pseudoscalar-fermion theory with an internal-symmetry group G and in which the coupling matrix furnishes a representation of G is considered. A representation is said to be stagnant if the associated theory is stagnant. We show that Cartan's four families A,B,C,D and the exceptional algebra G_2 possess no stagnant representation. On the basis of this result we conjecture that there are no asymptotically free quantum field theories in four dimensions. Some possible asymptotic behaviors of field theories are also described. (auth)

26437 LIGHTLIKE ASYMPTOTIC BEHAVIOR OF LOCAL OPERATORS AND THE VACUUM ANNIHILATION PROPERTY OF "LIGHTLIKE CHARGES". Miklavc, A.; Woo, C. H. (Center for Theoretical Physics, Department of Physics and Astronomy, University of Maryland, College Park, Maryland 20742). Phys. Rev. D 7: No. 12, 3754-3762 (15 June 1973).

It is shown that under lightlike translations the matrix elements of local operators between suitable states decrease asymptotically faster than any inverse power of the amount of translations. This result is used to establish the vacuum annihilation property of "lightlike charges." The physical basis of these asymptotic behaviors is discussed, and the circumstances under which these can be associated with the propagation of the virtual hadrons in a projectile are analyzed. (auth)

26438 HYPERCONTRACTIVITY FOR FERMIONS. Wilde, I. F. (Seminar for Theoretical Physics, E.T.H.,8049 Zürich, Switzerland). J. Math. Phys. (N.Y.) 14: No. 6, 791-792 (June 1973).

If T is a fermion one-particle operator, with $||T|| < 1$, then T induces a bounded map from $L^2(C) \rightarrow L^p(C)$, for some $p > 2$, where C is the fermion von Neumann algebra. The proof is an adaptation to the fermion case of the corresponding proof for bosons given by Nelson. This leads to a generalization of a theorem of Gross, inasmuch as T is not required to be self-adjoint. (auth)

26439 EQUIVALENCE THEOREM IN QUANTUM FIELD THEORY. Efimov, G. V.; Rutenberg, M. L. (Joint Inst. for Nuclear Research, Dubna, USSR). Teor. Mat. Fiz.; 16: No. 2, 186-196(Aug 1973). (In Russian).

A regularization procedure is introduced in the framework of standard methods in quantum field theory. It provides the equality

of the S-matrices corresponding to the interaction Lagrangians which are connected by a local transformation of field variables. (auth)

26440 STRONG COUPLING METHOD IN THE STATIC SOURCE MODEL. Tyurin, N. E.; Shurgaya, A. V. (Inst. of High Energy Physics, Serpukhov, USSR). Teor. Mat. Fiz.; 16: No. 2, 197-212 (Aug 1973). (In Russian).

The interaction of static source with symmetric scalar and pseudoscalar field is considered on the basis of N. N. Bogolubov's method in the strong coupling theory. (auth)

26441 GENERALIZED HAMILTONIAN FORMULATION OF THE STRICTLY LOCALIZABLE LAGRANGIAN FIELD THEORY. Kasymzhanov, M. A.; Khodzhaev, L. Sh. (Inst. of Nuclear Physics, Baku). Teor. Mat. Fiz.; 16: No. 2, 213-223(Aug 1973). (In Russian).

The basic axioms of the theory are formulated in terms of the coefficient functions of the generalized Bogolubov–Shirkov Hamiltonian. The advanced representation for these coefficient functions is given. Introducing the S-matrix into the dynamics of the theory is performed by means of the density of the generalized Bogolubov–Shirkov Hamiltonian. Some properties of the Hamiltonian are established. (auth)

26442 ASYMPTOTICAL FIELDS AND SCATTERING MATRIX IN THE LOWEST SECTOR OF THE LEE MODEL. Dadashev, L. A. (Inst. of Physics, Baku). Teor. Mat. Fiz.; 16: No. 2, 157-168 (Aug 1973). (In Russian).

It is shown that in the lowest sector of the Lee model there exist the asymptotical fields, which can be interpreted in terms of particles. The scattering matrix calculated by means of these fields coincides with the S-matrix obtained by means of solving the Lippmann–Schwinger equation. (auth)

26443 NONLINEAR VECTOR FIELD WITH EXACT PARTICLE-LIKE SOLUTION WITH FINITE ENERGY AND PHASE WAVE. Kustanovich, I. M.; Morozov, V. A. Teor. Mat. Fiz.; 16: No. 2, 274-278(Aug 1973). (In Russian).

The relativistic model Lagrangian, the corresponding nonlinear wave equation (with three arbitrary constants m_1, m_2 and m_3) for the complex 4-vector field and the exact particle-like solution of the latter are given. The energy, momentum, "charge" and spin of "particles" are calculated in terms of m_1, m_2, and m_3. The values of m_1, m_2 and m_3 are given, for which the parameters of particles agree with corresponding parameters of the π-mesons. For these values of m_1, m_2 and m_3 the nonlinearity reveals itself effectively only within the particle. (auth)

26444 STATISTICAL MECHANICS AND FIELD THEORY. Lectures Given at the 1971 Haifa Summer School, with Additional Contributions from Participants at the 1971 Europhysics Conference. Sen, R. N.; Weil, C. (eds.). New York; John Wiley and Sons, Inc. (1972). 335p. $33.50.

Separate abstracts were prepared for 12 of the 18 lectures. The remaining 6 lectures were outside the subject scope of NSA. (JFP)

For abstracts of individual lectures see: 25993, 25994, 26027, 26028, 26421, and 26445–26451.

26445 ALGEBRAIC ASPECTS OF WIGHTMAN FIELD THEORY. Borchers, H. J. (Univ., Goettingen, Ger.). pp 31-79 of Statistical Mechanics and Field Theory. Sen, R. N. (ed.). New York; John Wiley and Sons, Inc. (1972).

Wightman field theory is reformulated as a theory of positive linear functionals over a test-function algebra. Some properties of this algebra are derived. Examples are given showing that this setting of quantum field theory is suitable for investigating the nonlinear aspects of field theory. (auth)

26446 HAAG'S THEOREM. Guenin, M. (Univ., Geneva). pp 111-119 of Statistical Mechanics and Field Theory. Sen, R. N. (ed.). New York; John Wiley and Sons, Inc. (1972).

Haag's theorem and its consequences are reviewed. As a way out, time evolution of field operators is described without using the Hamiltonian. Although this enables one to bypass Haag's theorem, it brings one into contact with unsolved problems concerning the vacuum state, some of which are pointed out. (auth)

26447 COMBINATORIAL ANALYSIS OF THE LIE IDENTITIES IN FIELD THEORY. Joseph, A. (Tel-Aviv Univ., Israel). pp 121-131 of Statistical Mechanics and Field Theory. Sen, R. N. (ed.). New York; John Wiley and Sons, Inc. (1972).

The Lie bracket structure of the commutator between fields (or currents) taken at different space-time points is investigated. Calculations performed at a formal algebraic level are given a rigorous setting, and their combinatorial structure is examined. The modification to this structure in the original field theoretic framework is discussed by way of examining the divergences which arise. (auth)

26448 STUDYING SPATIALLY CUTOFF $(\varphi^{2n}_n)_2$ HAMILTONIANS. Simon, B. (Princeton Univ., NJ). pp 197-224 of Statistical Mechanics and Field Theory. Sen, R. N. (ed.). New York; John Wiley and Sons, Inc. (1972).

Various methods of studying the properties of Hamiltonians of spatially cutoff two-dimensional self-coupled boson fields (the so-called $P(\varphi)_2$ model are reviewed. Semiboundedness, selfadjointness and spectral properties are discussed. The methods for removing the cutoff are not discussed. (auth)

26449 CONNECTION BETWEEN WIGHTMAN AND LSZ FIELD THEORY. Steinmann, O. (Swiss Inst. for Nuclear Research, Villigen). pp 269-291 of Statistical Mechanics and Field Theory. Sen, R. N. (ed.). New York; John Wiley and Sons, Inc. (1972).

Traditionally one distinguishes between two formulations of axiomatic field theory: the Wightman formulation and the LSZ formulation. The latter is specially adapted to the needs of particle physics by stressing the importance of the S-matrix and related notions. The former is more concerned with local aspects and is therefore better suited for the discussion of particular field theory models, i.e. for getting a hold on dynamics. In the present lectures the two formulations are combined by developing the LSZ theory as a special case of a Wightman theory. The Wightman axioms are stated in the special form in which they are needed for the establishment of a scattering formalism. Such a scattering formalism is discussed. Asymptotic conditions are derived which allow the introduction of the notion of particle. The S-matrix is defined, and its properties discussed. Expressions for its matrix elements in terms of the basic fields (the so-called reduction formulae) are derived. A short discussion of the GLZ theorem which gives a complete characterization of an LSZ theory in terms of its retarded functions, a set of c-number functions closely related to the Green's functions of the theory is given. An attempt is made to make my statements mathematically rigorous. Most proofs are however, only sketched. (auth)

26450 UNSTABLE PARTICLES IN FIELD THEORY. Steinmann, O. (Swiss Inst. for Nuclear Research, Villigen). pp 293-302 of Statistical Mechanics and Field Theory. Sen, R. N. (ed.). New York; John Wiley and Sons, Inc. (1972).

A field-theoretical description of long-lived unstable particles is discussed assuming that these particles are associated with poles on the second sheet of the Green's functions of the underlying fields. The spatio-temporal evolution of scattering events of stable particles is discussed under certain smoothness assumptions for the Green's functions. It is shown that second-sheet poles near the real axis induce geometrical features in these processes, which can be interpreted as manifestations of unstable particles in intermediate stages. An S-matrix for processes involving these unstable particles is defined in an approximate sense and its properties discussed. In particular, S is unitary in a suitable approximation. (auth)

26451 ERGODICITY IN SOLVABLE MODELS. Verbeure, A. (Univ., Leuven, Belg.). pp 303-309 of Statistical Mechanics and Field Theory. Sen, R. N. (ed.). New York; John Wiley and Sons, Inc. (1972).

Conditions are given for ergodicity for Fermi lattice systems. The result is compared with ergodicity for classical systems. (auth)

Gravitation and General Relativity

Refer also to abstracts 25834 and 26435.

26452 (IC-73/94) GRAVITATIONAL WAVES AND MACH's PRINCIPLE. Sciama, D. W. (International Centre for Theoretical Physics, Trieste (Italy)). Jul 1973. 17p. (CONF-730654-1). Dep. NTIS (U. S. Sales Only) $3.00.

From international conference on waves and gravitational radiations; Paris, France (18 Jun 1973).

In formulating Mach's principle in general relativity it is essential to distinguish between wave and static contributions of $T^{\mu\nu}$ to $g^{\mu\nu}$. The former propagate on or inside the light cone, while the latter are instantaneous. Thus it is not correct in general to state Mach's principle in terms of the vanishing of a surface integral at infinity in the Green's function representation of general relativity. A brief description is given of Raine's solution of this problem, and its consequences are compared with recent observations of the angular distribution of the microwave background. (auth)

26453 CONNECTION BETWEEN THE BEL-ROBINSON TENSOR AND GRAVITATIONAL RADIATION. Garecki, J. (Jagellonian Univ., Krakow). Acta Phys. Pol.; B4: No. 4, 573-574(1973).

A new method is presented which allows one to connect the Bel-Robinson tensor with the gravitational radiation. The method is based on the Einstein canonical pseudotensor. (auth)

26454 FIERZ ENERGY–MOMENTUM TENSOR FOR A GRAVITATIONAL FIELD. Cavalleri, G. (Centro Informazioni Studi Esperienze, Milan); Spinelli, G. Lett. Nuovo Cim.; 8: No. 1, 67-70(1 Sep 1973).

It is shown that the energy–momentum tensor studied by Fierz is so particular that no general conclusions can be drawn. Also by equating to zero the divergence of the total energy–momentum, equations of motion are obtained postulated by Birkhoff which cannot be derived by an action principle. (JFP)

26455 OPTICAL INTERPRETATION OF SCALARS ASSOCIATED WITH THE KERR AND VAIDYA SOLUTIONS. Misra, M. (Gujarat Univ., Ahmedabad, India). Lett. Nuovo Cim.; 7: No. 17, 922-924(25 Aug 1973).

The Kerr–Schild metric was previously studied, and it was found that the scalars played an important role. An interpretation of these scalars is given in terms of the optical scalars. (JFP)

26456 RADIATION OF ULTRA-RELATIVISTIC PARTICLES IN THE GRAVITATIONAL FIELD. Khriplovich, I. B.; Shuryak, E. V. (Inst. of Nuclear Physics, Novosibirsk, USSR). Lett. Nuovo Cim.; 7: No. 17, 911-914(25 Aug 1973).

The character of radiation in a gravitational field is discussed qualitatively, and simple estimates are obtained for the total intensity of radiation, its angular and spectral distributions. Infinite motion as well and circular motion as considered. The net energy loss is found for the problem of radiation of an ultra-relativistic particle with impact parameter ρ passing through the Schwarzschild field. (JFP)

26457 PHENOMENOLOGY OF GRAVITATION. Polievktov-Nikoladze, N. M. (Tbilissi State Univ., USSR). Zh. Eksp. Teor. Fiz.; 64: No. 6, 1902-1917(Jun 1973). (In Russian).

It is shown that within the limits of the equivalence principle, weak gravitation is practically determined by extremely general principles, as a result of which nonrelativistic effects can only contribute phenomenological information. It is shown that theories of the Brans and Dicke kind can only lead to distorted information. For this reason, nonrelativistic findings should be regarded phenomenologically. Precise criteria were obtained for a broad class of equations, including the Einstein equations. It is demonstrated that the curvature of a ray can yield precise information concerning the canonicity of equations and the interaction of gravitational fields. Two types of gravitational waves are indicated that can yield direct information of short-range action. Phenomenologically, it is shown that if the existing findings on ray curvature and on the advance of the perihelion are corroborated, then the most probable conclusion is that, within the limits of the equivalence principle, the field of gravitation is a curvature-tensor field but obeys equations higher than second order. The basic difference between gravitation and other interactions is pointed out. It is shown that the Eötvös experiment would not have detected all violations of the equivalence principle. An experiment is suggested for their verification and evaluations are given on the basis of electromagnetic findings. An upper limit was found for the constants of direct interaction of matter with long-range nonmetric fields. (auth)

26458 GRAVITATIONAL LAGRANGIAN AND SOME IDENTITIES IN THE NEWMAN–PENROSE FORMALISM. Herrera, L. A. (Universidad Central de Venezuela, Caracas). Nuovo Cim.; 17A: No. 1, 48-54(1 Sep 1973).

A Lagrangian density is built, from which the equations of the gravitational field are deduced in the Newman–Penrose formalism The use of the Noether theorem enables one to deduce some of the identities which have been used beforehand, in the classification of the Newman–Penrose equations. In the second part of the work, a similar treatment for the electromagnetic field is described. (auth)

26459 MAGNETIC FIELD DUE TO THE SELF-GRAVITY-INDUCED ELECTRIC POLARIZATION OF A ROTATING MASSIVE BODY. Kumar, N. (International Centre for Theoretical Physics, Trieste, Italy); Nandini, R. Phys. Rev. D 7: No. 12, 3586-3589 (15 June 1973).

The notion of the gravity-induced electric field has been applied to an entire self-gravitating massive body. The resulting electric polarization of the otherwise neutral body, when taken in conjunction with the latter's rotation, is shown to generate an axial-magnetic field of the right type and order of magnitude for certain astrophysical objects. In the present treatment the electric polarization is calculated in the ion-continuum Thomas–Fermi approximation while the electrodynamics of the continuous medium is treated in the nonrelativistic approximation. (auth)

26460 THE CHARACTERISTIC DEVELOPMENT OF TRAPPED SURFACES. Demmie, P. N. (University of Pittsburgh at Johnstown, Johnstown, Pennsylvania 15904); Janis, A. I. J. Math. Phys. (N.Y.) 14: No. 6, 793-802 (June 1973).

Conditions are found that are sufficient to insure the development of trapped surfaces in space-times whose metrics satisfy the Einstein field equations in vacuum or in the presence of a massless scalar field. These conditions involve a topological requirement that a certain two-surface be compact and inequalities that must be satisfied by certain pieces of the characteristic data determining these space-times. It is shown that a particular piece of data playing an important role in these inequalities is related to angular momentum. (auth)

26461 FOUNDATIONS FOR A THEORY OF GRAVITATION THEORIES. Thorne, K. S.; Lee, D. L.; Lightman, A. P. (California Institute of Technology, Pasadena, California 91109). Phys. Rev. D 7: No. 12, 3563-3578 (15 June 1973).

A foundation is laid for future analyses of gravitation theories. This foundation is applicable to any theory formulated in terms of geometric objects defined on a 4-dimensional space-time manifold. The foundation consists of (i) a glossary of fundamental concepts; (ii) a theorem that delineates the overlap between Lagrangian-based theories and metric theories; (iii) a conjecture (due to Schiff) that the weak equivalence principle implies the Einstein equivalence principle; and (iv) a plausibility argument supporting this conjecture for the special case of relativistic, Lagrangian-based theories. (auth)

26462 ANALYSIS OF THE BELINFANTE-SWIHART THEORY OF GRAVITY. Lee, D. L.; Lightman, A. P. (California Institute of Technology, Pasadena, California 91109). Phys. Rev. D 7: No. 12, 3578-3586 (15 June 1973).

We show that the Belinfante-Swihart (BS) theory can be reformulated in a representation in which uncharged matter responds to gravity in the same way as in metric theories. The BS gravitationally modified Maxwell equations can also be put into metric form to first order in the deviations of the physical metric from flat space, but not to second order; consequently, the theory is nonmetric except in first order. We also show that the theory violates the high-precision Eötvös-Dicke experiment, but cannot be ruled out by the gravitational precession of gyroscopes. (auth)

26463 RADIATING KERR METRIC. Vaidya, P. C.; Patel, L. K. (Gujarat University, Ahmedabad-9, India). Phys. Rev. D 7: No. 12, 3590-3593 (15 June 1973).

A nonstatic solution of Einstein's equations corresponding to a field of flowing radiation is presented. The solution is algebraically special and contains two shear-free geodetic null congruences. It has the symmetry of the Kerr solution and when a certain parameter is put equal to zero the solution becomes static and reduces to the Kerr solution. (auth)

26464 VECTOR-METRIC THEORY OF GRAVITY. Hellings, R. W.; Nordtvedt, K. Jr. (Department of Physics, Montana State University, Bozeman, Montana). Phys. Rev. D 7: No. 12, 3593-3602 (15 June 1973).

A theory in which gravity is produced by a massless vector field in addition to the usual metric field is presented and found to be compatible with present solar-system experiments and cosmological expansion. A special case predicts the same first post-Newtonian gravitational experimental results as general relativity. (auth)

26465 EXPLICIT GREEN FUNCTION REPRESENTATION OF COVARIANT WAVE EQUATIONS IN WEAK GRAVITATIONAL FIELDS. I. LINEARIZED EINSTEIN GRAVITATIONAL FIELD. John, R. W. (Zentralinstitut fuer Astrophysics, Potsdam, Ger.). Ann. Phys. (Leipzig); 29: No. 1, 27-36(1973). (In German).

The propagation equations for small perturbations of a background gravitational field satisfying the Einstein equations are considered. For the perturbation potential the covariantly generalized Einstein–Hilbert gauge is chosen. With the aid of the method used in bitensor Green's functions for the propagation equations in a weak vacuum field are given explicitly. The tail term is obtained to be an integral of the first-order Riemann curvature tensor. As an application of the formulas, Green's functions for perturbations of the Schwarzschild metric are calculated to first order in the mass parameter. (auth)

26466 EXPLICIT GREEN FUNCTION REPRESENTATION OF COVARIANT WAVE EQUATIONS IN WEAK GRAVITATIONAL FIELDS. I. Scalar D'Alembert Equation. John, R. W. (Zentralinstitut fuer Astrophysics, Potsdam, Ger.). Ann. Phys. (Leipzig); 29: No. 1, 15-26(1973). (In German).

The scalar wave equation in an external gravitational field is considered. In the weak-field approximation, the time-symmetric Green's function is built up via the invariant defining equation to first order in the perturbation parameter. The coefficients of the distributions are represented by four-dimensional Fourier integrals containing the Fourier transform of the first-order gravitational potential and Kummer's functions. (auth)

26467 AMPLIFICATION OF ELECTROMAGNETIC AND GRAVITATIONAL WAVES SCATTERED BY A ROTATING "BLACK HOLE". Starobinskii, A. A.; Churilov, S. M. (Inst. of Theoretical Physics, Moscow). Zh. Eksp. Teor. Fiz.; 65: No. 1, 3-11 (Jul 1973). (In Russian).

The amplification coefficient of electromagnetic and gravitational waves scattered by a rotating ≪black hole≫ whose gravitational field can be described by the Kerr metric is calculated. The condition of existence of the amplification effect is independent of the wave field spin. The maximal magnitude of the effect rapidly increases with increase of the spin and is considerable for gravitational waves with a small multipolarity if the angular momentum of the ≪black hole≫ is close to the maximal value. The amplification coefficient is the same for all modes and this implies that the Kerr metric is stable with respect to generation of electromagnetic and gravitational waves. (auth)

26468 DETERMINATION OF RECURRENT SPACE-TIMES OF THE SECOND ORDER. McLenaghan, R. G. (Univ. of Waterloo, Ont.); Thompson, A. H. Bull. Cl. Sci., Acad. Roy. Belg.; 58: 1099-1111(1972). (In French).

The second-order Lorentzian recurrent spaces are determined in 4-dimensions. These spaces form a subclass of the exact plane-wave space-times which are solutions of the Einstein-Maxwell equations. The first explicit examples of second order recurrent spaces which are not recurrent are given. (auth)

REACTOR TECHNOLOGY AND REGULATION

26469 (NP-19832) ANNUAL REPORT, 1972. (Eidgenoessisches Institut fuer Reaktorforschung, Wuerenlingen (Switzerland)). 30 Apr 1973. 65p. (In German). Dep. NTIS (U.S. Sales Only) $5.25.

Progress is reported for such long-term projects as fast gas-cooled breeder reactors, fuel program, reconstruction of the DIORIT, fuel economy, and pilot combustion facility. Educational activities are described with respect to lecturing at universities, post graduate work, practical reactor exercises, training courses, and reactor symposium. Scientific progress is presented separately for each department. A listing is given of publications, lectures, and patents. (HBG)

Power Reactors, Non-Breeding, BWR-Type

Refer also to abstracts 26490, 26647, 26678, 26687, 26689–26692, 26695–26697, 26701, 26704–26706, 26711, 26736, 26738, 26741–26746, and 26760.

26470 (CEA-CONF-2290) NONDESTRUCTIVE TESTING IN THE IN-SERVICE INSPECTION OF NUCLEAR REACTORS. Prot, A.; Saglio, R. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). 28 Mar 1973. 21p. (In French). (CONF-730463-1). Dep. NTIS (U. S. Sales Only) $3.25.

From COFREND meeting on the use of nondestructive testing for the surveillance of installations during operation; Paris, France (27 Apr 1973).

Nondestructive testing methods are shown to be related to the safety of nuclear reactors. The current state of development of these methods is shown to be insufficient. An example is given of a testing method which acts across the inoxidizable coating. Suggestions for future research are presented. (FR)

26471 (CONF-730801-, pp 273-298) INTERGRANULAR STRESS-ASSISTED CORROSION CRACKING OF TYPE 304 STAINLESS STEEL PIPING IN DRESDEN-I BWR SYSTEMS. Cheng, C. F. (Argonne National Lab., IL); Potter, E. E. Aug 1973.

From symposium on materials performance in operating nuclear systems; Ames, Iowa, USA (28 Aug 1973).

Five to ten years after Dresden-I began operation, several cracks in Type 304 stainless steel pipe sections were reported. A few of these cracks resulted in seeping leaks, which were detected by the radiation leak sensing system, located by careful visual and ultrasonic inspections, and confirmed by dye penetrant and metallographic examination. The partially through-wall and hairline leaking cracks propagated from the ID surface through the pipe wall in and near the heat-affected zone of the weld joints and in the straight-run sections. These branching circumferential cracks were intergranular and exhibited localized ductile tearing. All defective areas were found in the recirculating piping (3 to 6 in., Schedule 80) of the secondary steam-generator system. At times, these defective piping sections were exposed to partially stagnant water containing relatively higher oxygen (0.3-3.0 ppM) than under normal reactor operating conditions (0.2 ppM). A cold-worked layer of disturbed metal is a prerequisite for the initiation of cracking. When cold working was eliminated, no cracking was reported on the replaced piping. The mechanism of cracking is associated with intergranular stress-assisted corrosion which occurs in two stages. The initiation stage is caused by excessive localized stress (beyond initial yield) concentrated at the surface imperfections, which provide initial sites for preferential microscopic tunneling. The propagation stage proceeds along the grain boundary in alternating steps: (a) preferential anodic dissolution, and (b) mechanical tearing at the yielding crack tip. 12 figures. (auth)

26472 (CONF-730801-, pp 299-324) REACTOR STRUCTURAL MATERIALS ENVIRONMENTAL EXPOSURE PROGRAM. Gordon, G. M.; Blood, R. E. (Vallecitos Nuclear Center, Pleasanton, CA). Aug 1973.

From symposium on materials performance in operating nuclear systems; Ames, Iowa, USA (28 Aug 1973).

A stress corrosion cracking (SCC) surveillance program was conducted at Dresden-1 and Humboldt Bay Power Station No. 3. Several thousand stressed-bend and pressurized tube specimens have been exposed to the 550°F BWR environment for up to ten years and their susceptibility to SCC has been monitored during each reactor refueling outage. The evaluation has covered a range of structural alloys, stresses, and neutron flux levels. Materials studied include the austenitic, ferritic, and martensitic stainless steels, nickel-base alloys, and precipitation-hardened stainless alloys. Variables investigated include metallurgical condition (degree of cold work, heat treatment and sensitization), welding, and the effects of tight crevices. SCC data obtained from the reactor exposure program correlates well with information generated in laboratory studies performed in simulated high temperature oxygenated water environments as well as with actual reactor experience. 6 tables, 15 figures. (auth)

26473 (IRS-T-24, pp 64-88) OPERATING EXPERIENCE WITH REACTOR PROTECTION SYSTEMS. Peuster, K. (Heissdampfreaktor-Betriebsgesellschaft mbH, Kahl, Ger.); Hofmann, W.; Knaeulein, H.; Schmidl, J.; Wirth, W. Apr 1973. (In German).

The expectations held by a public utility towards a reactor protection system are compiled and compared with the features presented by present reactor protection systems and the development undergone with them. There follows a resume of the single reports on practical experiences with the reactor protection systems in the four nuclear power plants of VAK, KRB, KWO and KWL. (auth)

26474 (NEDO-10846) BWR CORE SPRAY DISTRIBUTION. Licensing Topical Report. Simon, T. W.; Shields, C. M. (General Electric Co., San Jose, Calif. Atomic Power Equipment Dept.). Apr 1973. 62p.

To verify the design of BWR core spray systems, full-scale mockups are built and instrumented to measure the distribution of spray flow for a variety of flow conditions. This verification has been performed for each core spray sparger design used in BWRs since the first application of spray cooling by a peripheral sparger in the Oyster Creek Nuclear Power Plant. Introduction of the BWR/6 product line means that testing will be performed to verify the adequacy of the BWR/6 core spray sparger design as has been done in the past. The core spray testing hardware and procedures are described. The criteria by which the acceptability of a core spray sparger design is determined are discussed and compared to the expected results during a hypothetical BWR/6 loss-of-coolant accident. The document verifies the acceptability of BWR core spray sparger designs and required core spray flow rates. 4 references. (auth)

26475 (WASH-1260) EVALUATION OF INCIDENTS OF PRIMARY COOLANT RELEASE FROM OPERATING BOILING WATER REACTORS. (Directorate of Regulatory Operations (AEC), Washington, D. C.). 30 Oct 1972. 140p. Dep. NTIS $9.00.

Since 1967, licensees of nuclear power plants have reported the inadvertent release or leakage of primary coolant during plant operations on more than 50 occasions. The incidents reported since 1967 have been screened, based on the quantity of primary coolant released during the incident, the number and safety significance of equipment malfunctions or operator errors that occurred, and the severity of the damage to plant equipment. Based on these general criteria, eight incidents were identified during the screening process for consideration in the evaluation. Each incident is evaluated with respect to the initiating mechanism, the sequence of events, damage to plant equipment, corrective actions, supporting documentation, and the significance with respect to public safety. (auth)

26476 CIRCULATING SYSTEM FOR A NUCLEAR PRESSURE VESSEL. Schill, J. H. (to Sulzer Brothers Ltd.). U. S. Patent 3,748,229. 24 Jul 1973. Filed date 2 Jun 1971. 6p.

The turbines for driving the circulating pumps are connected in series in the flow of the working medium. The turbines can be arranged in a closed ring along with a pump and can be provided with by-pass lines should it be necessary to shut down one or more turbines. Also, sets of serially connected turbines can be connected in parallel. (Official Gazette)

26477 FUEL ASSEMBLIES CONTAINING UO_2 AND PuO_2–UO_2 FOR WATER COOLED NUCLEAR REACTORS. Sofer, G. A.; Tulenko, J. S.; Tomonto, J. R. (to United Nuclear Corp.). U. S. Patent 3,745,069. 10 Jul 1973. Filed date 30 Oct 1969. 8p.

A water cooled nuclear reactor typically includes a core comprising a plurality of rod-type nuclear fuel assemblies separated by water gaps. A fuel assembly for utilizing plutonium-bearing fuel rods comprises a plurality of fuel rods containing uranium oxide for occupying the regions near the large water gaps between adjacent assemblies and one or more fuel rods containing a mix-

ture of plutonium oxide and uranium oxide disposed in the interior of the assembly. Preferably the plutonium oxide is deployed in the minimum number of rods consistent with the power peaking requirements of the reactor. (Official Gazette)

26478 REVIEW OF TWO-PHASE FLOW INSTABILITY. Boure, J. A. (CEN, Grenoble, France); Bergles, A. E.; Tong, L. S. Nucl. Eng. Des.; 25: No. 2, 165-192(1973).

Boiling flow in a water-cooled reactor, an evaporator, or an electronic cooling system is susceptible to thermal-hydrodynamic instabilities, which may cause flow oscillations of constant amplitude or diverging amplitude. These oscillations could induce boiling crisis, disturb control systems, or cause mechanical damage. The causes and mechanisms of these instabilities are identified. Based on their mechanisms, various types of instabilities are classified and tabulated. The parametric effects on flow instability, observed experimentally, are systematically presented. Various analytical techniques for predicting the instability threshold are reviewed in terms of their applicability and accuracy. 94 references. (auth)

26479 SAFETY DEVICE FOR PRESSURE VESSELS: ESPECIALLY FOR NUCLEAR REACTORS. Schabert, H. P. (to Siemens Aktiengesellschaft). U. S. Patent 3,753,853. 21 Aug 1973. Priority Date 25 Sep 1969, F. R. Germany. 6p.

A safety device for a pressure vessel is described which has a cover to which tubes are secured and includes a capture cover disposed on the outside of the pressure vessel cover. The capture cover becomes effective for covering the pressure vessel pursuant to rupture of the pressure vessel cover. The capture cover is formed with openings through which the tubes secured to the pressure vessel cover extend. It is removable from the pressure vessel together with the pressure vessel cover. (Official Gazette)

26480 INVESTIGATION OF CORROSION FAILURES IN NUCLEAR REACTOR COMPONENTS. Wylie, R. D. (Southwest Research Inst., San Antonio). pp 190-196 of III Interamerican Conference on Materials Technology. Buenos Aires; Centro Regional de Ayuda Tecnica (1972).

From 3rd Inter-American conference on materials technology; Rio de Janeiro, Brazil (14 Aug 1972). See CONF-720832-.

The increased rate of generation of electric power by nuclear energy has focused attention on the structural integrity of nuclear reactor system components. This paper describes a number of service failures that have occurred in nuclear components of Elk River, La Crosse, and BONUS, and discusses the mechanisms related to these failures. Suggestions are made as to ways of avoiding similar failures. 11 figures. (auth)

Power Reactors, Non-Breeding, PWR-Type

Refer also to abstracts 26470, 26473, 26477–26479, 26594–26598, 26611, 26613, 26693, 26694, 26698–26700, 26702, 26703, 26707–26710, 26712–26735, 26737, 26739, 26740, 26748–26759, and 26761.

26481 (BAW-1388(Rev.1)) OCONEE 1 FUEL DENSIFICATION REPORT. (Babcock and Wilcox Co., Lynchburg, Va. (USA). Nuclear Power Generation Div.). Jul 1973. 121p. Dep. NTIS $8.25.

In July 1973, Babcock & Wilcox filed topical report BAW-10055 (Rev. 1), "Fuel Densification Report," which describes the methods to be used in analyzing fuel densification effects. An analysis of effects on fuel for Oconee Nuclear Power Station, Unit 1, is presented. The operation of Unit 1 at the rated power level of 2568 MW(t) is supported. Appendix B answers the questions of the AEC Directorate of Licensing Regulatory Staff. (auth)

26482 (BAW-10058) GASEOUS WASTE TREATMENT SYSTEM. Heck, K. C.; Marrero, T. R. (Babcock and Wilcox Co., Lynchburg, Va. (USA). Nuclear Power Generation Div.). May 1973. 66p. Dep. NTIS $5.50.

The gaseous waste treatment system is based on the selective absorption process developed at the Oak Ridge Gaseous Diffusion Plant. Pilot plant tests indicate that the radioactive level of offgas streams of current pressurized water reactors may be reduced by a factor as large as 1000. By isolating the problem isotopes, krypton and xenon, and collecting them in a concentrated volume for disposal, the gaseous waste treatment system provides an efficient and reliable method of reducing the radioactive levels of the effluent released to the environment. (auth)

26483 (BAW-10061) THREE-DIMENSIONAL POWER DISTRIBUTION ANALYSIS. Hassan, H. A.; Wittkopf, W. A. (Babcock and Wilcox Co., Lynchburg, Va. (USA). Nuclear Power Generation Div.). Jun 1973. 39p. Dep. NTIS $4.00.

The Babcock and Wilcox Physics Laboratory conducted critical experiments to determine the reliability of the PDQ07 analytical model in predicting detailed radial and axial power distributions for PWR cores. It is concluded that the PDQ07 analytical model can be applied to conservatively calculate all power operating conditions. (auth)

26484 (BAW-10068) KAPP4: DIGITAL COMPUTER PROGRAM FOR SOLUTION OF REACTOR KINETICS AND PRIMARY SYSTEM PRESSURE RESPONSE. Bingham, B. E.; Rhyne, W. R. (Babcock and Wilcox Co., Lynchburg, Va. (USA). Nuclear Power Generation Div.). Jun 1973. 52p. Dep. NTIS $4.75.

KAPP 4 is a digital computer program that solves the time-dependent neutron kinetics equations, the core heat transfer, the temperature response in the primary coolant loop, and the pressure in the pressurizer and loop. It includes options for any of the normal reactor trip signals, as well as decay heat and secondary coastdown in the steam generator. The heat transfer is based on the average fuel pin, which the program simulates. The program is characterized by speed and flexibility in accepting both fast and slow reactivity transients. The printout is compact and the running time is short. The printout for each time zone may be as little as four pages. The running time varies from two to three times the real problem time on the CDC-6600. The run time ratio may be larger depending on the simulation models chosen. (auth)

26485 (BAW-10069) RADAR: REACTOR THERMAL AND HYDRAULIC ANALYSIS DURING REACTOR FLOW COASTDOWN. Morgan, C. D.; Cheatwood, H. C.; Gloudemans, J. R. (Babcock and Wilcox Co., Lynchburg, Va. (USA). Nuclear Power Generation Div.). Jul 1973. 70p. Dep. NTIS $5.50.

The RADAR digital computer program performs a thermal analysis of a slow reactor transient such as the loss of a primary pump. The code computes, as a function of time, fuel pin temperatures, cladding surface temperatures, critical heat flux ratios, and coolant thermodynamic conditions when given the fuel pin heat rate and either the channel flow or pressure drop as a function of time. Because of the restriction of slow transients, RADAR requires very little computer time to analyze a typical problem. The run time for a typical case is 0.6 second per axial node per time step. Since the solution technique is implicit, there is no stability limitation on the size of the time increment. (auth)

26486 (BAW-10070) POWER TRAIN: GENERAL HYBRID SIMULATION FOR REACTOR COOLANT AND SECONDARY SYSTEM TRANSIENT RESPONSE. Christy, P. T.; Galan, V. J. (Babcock and Wilcox Co., Lynchburg, Va. (USA). Nuclear Power Generation Div.). Jul 1973. 50p. Dep. NTIS $4.50.

POWER TRAIN is a real-time hybrid computer simulation of a PWR nuclear power plant developed by Babcock & Wilcox's Nuclear Power Generation Division. It is used to predict the performance and behavior of major components in the primary and secondary loops over a wide range of plant conditions and operations. It is also used for detailed study of the integrated control system, which is accurately modeled. Three basic methods of equation solution are performed in the POWER TRAIN model. The first is the classic method of solving time-dependent, space-independent ordinary differential equations on an analog computer with the appropriate choice of scale factors. The second solution method is the continuous space, discrete time (CSDT) method of solving partial differential equations in both space and time. The third method is the simulation of various algebraic and differential equations of the system on the digital computer complement of the hybrid facility. General parameters for all the various components in the system are input in card form along with an initialization program, COMANCHE, which sets up the proper steady-state solution on the hybrid computer. This input data is a list of basic setpoints, pressures, flows, temperatures, volumes, masses, and the like, that specify the overall plant configuration. POWER TRAIN solves the time-dependent neutron kinetics equations, the reactor and steam generator heat transfer, the pressure in the pressurizer, and the temperature response of the primary and secondary system. It includes options for any of the reactor trip signals, as well as programmable primary flow coastdown. The program is characterized by on-line, real-time solutions to the equations and flexibility in accepting changes in plant parameters. Output is usually on a strip chart recorder. (auth)

26487 (BAW-10071) SPLIT: DIGITAL STEADY-STATE FLOW DISTRIBUTION CODE FOR VARIOUS PRIMARY SYSTEM

PUMP COMBINATIONS. Galan, V. J.; Miller, C. K. (Babcock and Wilcox Co., Lynchburg, Va. (USA). Nuclear Power Generation Div.). Jul 1973. 19p. Dep. NTIS $3.00.

SPLIT is a digital computer code that resolves the steady-state flow distribution in the primary coolant system of a PWR plant with various pump combinations. The program includes the option to determine the flow split for two- and three-loop systems. SPLIT is characterized by low running times and compact printout. Multiple-use runs are an option. (auth)

26488 (BAW-10073) PUMP: ANALOG-HYBRID REACTOR COOLANT HYDRAULIC TRANSIENT MODEL. Grandia, M. R. (Babcock and Wilcox Co., Lynchburg, Va. (USA). Nuclear Power Generation Div.). Jul 1973. 24p. Dep. NTIS $3.25.

The PUMP hybrid computer code simulates flow and pressure distribution; it is used to determine real time response to starting and tripping all combinations of reactor coolant pumps in a closed, pressurized, four-pump, two-loop primary system. The simulation includes the description of flow, pressure, speed, and torque relationships derived through pump affinity laws and from vendor-supplied pump zone maps to describe pump dynamic characteristics. The program affords great flexibility in the type of transients that can be simulated. (auth)

26489 (CONF-730801-, pp 229-253) MATERIALS PERFORMANCE AT THE INDIAN POINT NUCLEAR POWER STATION. Bahrenburg, H. H.; Flynn, A. W.; Rothstein, S.; Skulte, P.; Zeuthen, A. W. (Consolidated Edison Co., New York). Aug 1973.

From symposium on materials performance in operating nuclear systems; Ames, Iowa, USA (28 Aug 1973).

Four cases of materials failures have occurred in Indian Point Unit 1: (1) thermal fatigue of thermal sleeve and failure of primary coolant pipe, (2) failures of type 304 stainless-steel steam-generator tubes, (3) brittle fracture of Inconel X-750 roll pins in the control rod drive, and (4) stress corrosion cracking of waste evaporator bottoms piping (Type 304 stainless steel). Results of metallurgical and other examinations of each of these failures are given. (17 figures) (DLC)

26490 (CONF-730801-, pp 254-272) MATERIALS PERFORMANCE AT THE YANKEE NUCLEAR POWER STATIONS. Keenan, T. D. (Yankee Atomic Electric Co., Westboro, MA). Aug 1973.

From symposium on materials performance in operating nuclear systems; Ames, Iowa, USA (28 Aug 1973).

Some metallurgical problems encountered with the four Yankee plants in New England are described. The role of ferrite in welding of austenitic stainless steels is discussed, and it is felt that low-ferrite (2 to 3%) welds are acceptable and that, contrary to the AEC Safety Guide 31, a random statistical check for as-deposited ferrite content of production welds would be sufficient for verification of proper ferrite content. During the replacement of the sensitized safe-ends in the BWR vessel nozzles, it was found that the Severn ferrite gage could trace the high/low ferrite interface quite accurately. Two problems attending the welding of Inconel and stainless steel in close proximity are described. A problem of interior surface microfissures in cast stainless steel valves could have been prevented by liquid penetrant testing after the shop hydrostatic test. The difficulty of in-service ultrasonic examination of centrifugally cast components is pointed out. The steel irradiation surveillance program of Yankee Rowe is described briefly, and the uncertainty in predicting the end-of-life neutron fluence in Yankee Rowe is pointed out. (DLC)

26491 (ORNL-TM-4104) DIGITAL COMPUTER CODE FOR SIMULATING THE DYNAMICS OF DEMONSTRATION SIZE DUAL-PURPOSE DESALTING PLANTS USING A PRESSURIZED WATER REACTOR AS A HEAT SOURCE. Delene, J. G. (Oak Ridge National Lab., Tenn.). Sep 1973. Contract W-7405-eng-26. 128p. Dep. NTIS $8.50.

A digital simulator was developed for dual-purpose desalination plants of demonstration size (~50 Mgd) in which multistage flash (MSF) evaporators are coupled to a nuclear power plant through a back-pressure turbine. A pressurized water reactor (PWR) is used as the heat source. This simulator can calculate the time response of the coupled system, predicting pressures, temperatures, MSF plant liquid levels, reactor power, etc. The reactor, steam generator, and turbine plant system are described. The methods and equations used to describe the plant dynamics are discussed. Some sample results are also presented. The simulator can calculate a 1 hr transient in a 50 stage MSF plant coupled to the reactor-turbine plant in about 15 minutes on the IBM 360/91 at Oak Ridge National Laboratory. (auth)

26492 (ORNL-TM-4279) SENSITIVITY STUDIES OF THE PREDICTED DYNAMIC BEHAVIOR OF A FULL-SIZE NUCLEAR DUAL-PURPOSE DESALINATION PLANT. Delene, J. G. (Oak Ridge National Lab., Tenn.). Sep 1973. Contract W-7405-eng-26. 53p. Dep. NTIS $4.75.

Time response calculations were made for a full-size nuclear dual-purpose desalination plant, consisting of a pressurized water reactor (PWR) heat source and a multistage flash (MSF) evaporator. The various system perturbations calculated included electrical load demand changes, MSF plant venting changes, and loss of one or more of the MSF trains. Alternate MSF plant brine flow equations and various plant control schemes were used. The results demonstrate feasible solutions to the problem of maintaining independence between water and power production over a wide operating range. Several problems which may be encountered in the coupling and control of large dual-purpose plants are discussed. (auth)

26493 (WCAP-8185(Vol.1)) REFERENCE CORE REPORT 17 × 17. (Westinghouse Electric Corp., Pittsburgh, Pa.). Sep 1973. 298p.

Information on the mechanical and nuclear design of Westinghouse pressurized water reactors with 17 × 17 fuel rod arrays is presented. (JWR)

26494 (WCAP-8185(Vol.2)) REFERENCE CORE REPORT 17 × 17. (Westinghouse Electric Corp., Pittsburgh, Pa.). Sep 1973. 106p.

Information on the thermal and hydraulic design of Westinghouse pressurized water reactors with 17 × 17 fuel rod arrays is presented. (JWR)

26495 SHIELD FOR NUCLEAR REACTOR VESSEL. Gaines, A. L.; Notari, G. V. (to Combustion Engineering, Inc.). U. S. Patent 3,744,660. 10 Jul 1973. Filed date 30 Dec 1970. 6p.

A protective shield for a nuclear reactor vessel is disclosed that is operative to reduce the impact strength of high pressure fluid released as a result of a reactor accident and also to prevent the expulsion of high velocity fragments from the vessel. The shield is constructed of a plurality of independent cylindrical rings that are axially secured by tie rods. The tie rods are adapted to expand in the event of an inordinate buildup of pressure behind the shield whereby the rings can be displaced to create narrow openings through which the fluid can be released at a reduced rate. (Official Gazette)

26496 CE SYSTEM-80 INTRODUCED AT VGB ANNUAL CONFERENCE. Nucl. Eng. Int.; 18: No. 207, 646-648(Aug 1973).

From power plant engineering congress; Vienna, Austria (26 Jun 1973).

The main item discussed is the new system-80 PWR concept presented by Combustion Engineering. Comparison is made between the new System-80 and the earlier PWR design. New features are facilitated by a new approach to control rod configuration and the design basis is that of a self-generated plutonium recycle. Changes in the control rod system and in in-core instrumentation are described. The final design of the emergency core cooling system is still to be decided. Dual real-time computers are used for core monitoring and for logging plant functions. Other papers presented at the meeting are briefly referred to. (UK)

26497 MODULAR FUEL ROD SPACER ASSEMBLY FOR NUCLEAR REACTOR FUEL ASSEMBLIES. Donck, H. A. (to United Nuclear Corp.). U. S. Patent 3,753,855. 21 Aug 1973. Filed Date 15 Jun 1970. 8p.

A fuel rod spacer assembly comprises a cellular spacer array and, for each fuel rod, a bearing clip comprising a pair of linked split ring rod embracing portions proportioned to extend around substantially more than 180° of the rod circumference. A pair of spring tabs on the split rings are provided for releasably engaging the cellular spacing array in order to prevent longitudinal displacement of the bearing clip. This spacer assembly can be easily fabricated because the bearing clips need not be formed as a part of the cellular array. The fuel rods can be transversely loaded into the bearing clips and longitudinally loaded into the cellular array without contact against tight, previously-fixed spacers. (Official Gazette)

26498 TRAINING THE NUCLEAR PLANT STAFF. Deddens, J. C. (Babcock and Wilcox Co., Lynchburg, VA). Instrum. Power Ind.; 15: 13-20(1972).

From 15th international instrumentation in the power industry; Dallas, Texas, USA (22 May 1972). See CONF-720595-.

The methods used at the Babcock and Wilcox Company to train personnel for pressurized-water power reactors are described. The use of course studies, lectures, and reactor simulators in the training program is reviewed. (DCC)

26499 BEHAVIOR OF THE ARDENNES POWER PLANT WHEN DISTURBANCES OCCUR IN THE POWER TRANSMISSION

NETWORK. Marchal, K. (Electricite de France, Paris). Energ. Nucl. (Paris); 15: No. 2, 109-115(Mar 1973). (In French).

The principal characteristics of the installation are presented together with the main requirements of the power supplies for the utilities and the acceptable transition loads. The behavior of the installation with certain areas blocked-off is described together with the behavior associated with voltage and frequency variations. The tests and adjustments necessary to obtain an acceptable performance for an area in the case of a disturbance in the transmission network are presented. (FR)

Power Reactors, Non-Breeding, Graphite Moderated

Refer also to abstracts 25236, 26542– 26544, 26546, 26547, 26672, 26688, and 26747.

26500 (AERE-R-7414) TRANSIENT MODEL FOR THE CALCULATION OF THE CORROSION RATE OF AN H.T.R. CORE UNDER FAULT CONDITIONS. Hawtin, P.; Huber, R. A.; Wilmore, D. (Atomic Energy Research Establishment, Harwell (England)). Apr 1973. 23p. Dep. NTIS (U.S. Sales Only) $3.25.

A burst heat exchanger tube in an H.T.R. can lead to very rapid ingress of water. It is possible that during the initial phases of such an incident, very high rates of corrosion will occur in the graphite core. Under these conditions the steady state models used for calculating the core corrosion rate under normal operating conditions may not be adequate and a transient model will then become essential. A suitable transient model is developed. The model assumes cylindrical symmetry, and that diffusion is the sole mechanism of transport into and out of the graphite pores. The predictions of the model have been compared with those of the corresponding steady state model under conditions typical of a burst heat exchanger incident. The predictions of the two models agree closely. Reasons for the agreement are discussed. (auth)

26501 (CONF-730801-, pp 325-358) BEHAVIOR OF STRUCTURAL MATERIALS IN THE HIGH-TEMPERATURE GAS-COOLED REACTOR SYSTEM. Roberts, D. I.; Hedgecock, P. D.; Watson, J. F. (Gulf General Atomic Co., San Diego, CA). Aug 1973.

From symposium on materials performance in operating nuclear systems; Ames, Iowa, USA (28 Aug 1973).

The evolution of materials selection for the structural components of High Temperature Gas-Cooled Reactors (HTGRs) is reviewed, starting with a retrospective analysis of the performance of materials in the 40-MW(e) prototype Peach Bottom reactor, progressing through materials selection for the 330-MW(e) Fort St. Vrain HTGR, and concluding with an appraisal of materials selection for the large [1160 and 770 MW(e)] reactors now designed for commercial operation. The report emphasizes various phenomena that must be considered in relation to materials selection for an HTGR: irradiation damage; corrosion and tribological effects; creep and creep/fatigue interaction phenomena; and oxidation and stress corrosion from water/steam secondary coolant. Work to qualify materials for operation under these conditions comprised laboratory experimental studies, supplemented by operating experience from Peach Bottom and the surveillance program in that reactor together with international programs in support of the HTGR. Results of the more pertinent studies are summarized. 10 tables, 17 figures. (auth)

26502 (CONF-731004-1) INTERIM REPORT ON FISSION PRODUCT RELEASE DURING OPERATION OF THE SECOND PEACH BOTTOM CORE. de Nordwall, H. J.; Kolb, J. O.; Dyer, F. F.; Martin, W. J. (Oak Ridge National Lab., Tenn.). [nd]. 11p. Dep. NTIS $3.00.

From International conference on nuclear fuel performance; London, UK (15 Oct 1973).

The results of experiments that describe the releases and distribution of rare gases, iodine, cesium and other fission products during the operation of the second Peach Bottom HTGR Core are presented. (auth)

26503 (ORNL-TM-4207) FABRICATION AND CHARACTERIZATION OF PLUTONIUM TEST ELEMENT FTE-13: AN HTGR TEST ELEMENT CONTAINING PuO_{2-x}, $Th_{0.75}Pu_{0.25}O_{2-x}$, AND ThO_2. Sanders, C. F.; Sease, J. D. (Oak Ridge National Lab., Tenn.). Aug 1973. Contract W-7405-eng-26. 68p. Dep. NTIS $5.50.

Plutonium is potentially a very attractive fuel for high-temperature gas-cooled reactors, in which it would replace makeup ^{235}U that is required when operating on the ^{233}U-Th fuel cycle. A process and materials were developed for the plutonium test element that is being irradiated in the Peach Bottom Reactor and the plutonium-bearing fuel components for it were fabricated. The fuel element contained fissile kernels of PuO_2 and ThO_2–25% PuO_2 prepared by sol-gel procedures. Successive layers of low-density isotropic carbon, high-density isotropic carbon, silicon carbide, and high-density isotropic carbon were applied. Fabrication of fuel rods by the slug injection process produced a coated-particle body bound together by a carbonaceous binder. The fabrication and the characterization of these plutonium-bearing components are described. (auth)

26504 (RD/B/M-2712) REDUCTION IN LOAD CARRYING CAPACITY OF $\frac{5}{8}$" AND $\frac{1}{2}$" WHITWORTH BOLTS DUE TO MATERIAL SAMPLING. White, B. I. (Central Electricity Generating Board, Berkeley (England). Berkeley Nuclear Labs.). Jun 1973. 9p. Dep. NTIS (U.S. Sales Only) $3.00.

The problem of corrosion on certain structural bolted fastenings in Magnox reactors has made it necessary to conduct a materials analysis on a sample of those used in critical situations. Since material specimen removal weakens the bolt structure a series of tests were conducted to assess the loss in tensile strength due to drilling sample holes in bolt heads. (auth)

26505 NUCLEAR POWER STATION FOR A GASEOUS WORKING MEDIUM. Zimmermann, U. (to Sulzer Brothers, Ltd.). U. S. Patent 3,748,228. 24 Jul 1973. Priority date 17 May 1968, Switzerland. 8p.

The nuclear power station is constructed so that a working gas is conducted through a closed cycle. The reactor, power station and heat exchangers are accommodated in a pressure tight vessel while the starting point and end point of the working gas thermal work path are disposed in a sub-chamber with the power station. (Official Gazette)

26506 GADOLINIUM BURNABLE POISON FOR HIGH TEMPERATURE REACTORS. Noden, J. D. (Central Electricity Generating Board, Berkeley, Eng.). Nucl. Eng. Int.; 18: No. 207, 641-646(Aug 1973).

Burnable poisons may be used to advantage in high temperature reactors to improve the fuel cycle efficiency of their first fuel charge. A Gd_2O_3/Al_2O_3 ceramic poison, which could be used in a high temperature reactor with a prismatic core, has been developed for use in the form of rods located within the moderator bricks. Manufacture techniques have been satisfactorily developed, with the poison fabricated as rods or discs. Certain critical physical, chemical and mechanical properties of the material have been determined; constitutional studies have also been undertaken on the ceramic material. Its physical properties resemble those of dense alumina. The ceramic is chemically inert and is compatible with graphite for long periods up to temperatures of 1100°C, and hence no cladding of the poison is required. Irradiation experiments in Dragon have been successfully undertaken, with only small dimensional changes arising in the specimens receiving fast neutron doses up to about 1.2×10^{21} n/cm^2 at temperatures up to 920°C. (auth)

26507 DETERMINATION OF DIPOLE EXTRAPOLATION LENGTHS FOR USE IN HETEROGENEOUS AGR CORE CALCULATIONS. Bridge, M. J.; Cumpstey, J. M. (Central Electricity Generating Board, Berkeley, Eng.). J. Nucl. Energy; 27: No. 7, 465-484(Jul 1973).

A method has been developed for the calculation of the channel wall dipole extrapolation lengths required in heterogeneous calculations of neutron flux in an advanced gas-cooled reactor. Considerable improvement over previous methods has been achieved by treating the geometry of the fuel cluster explicitly and by using a P1 angular flux distribution at the channel wall. The calculation is done in one energy group using a collision probability method. Results are compared with other methods and with some measurements of cross-cluster flux tilts made at Berkeley Nuclear Laboratories. (auth)

26508 ANALYTICAL METHOD OF CALCULATING, TO A REASONABLE ACCURACY, STRESSES IN THE COATINGS OF HTR FUEL PARTICLES. Martin, D. G. (Atomic Energy Research Establishment, Harwell, Eng.). J. Nucl. Mater.; 48: No. 1, 35-46(Aug 1973).

An analytical model is developed which enables stresses in the layers of a triplex-coated particle, consisting of inner pyrocarbon, silicon carbide and outer pyrocarbon layers, to be calculated during the course of an isothermal irradiation in terms of the physical properties of the layers and the inner and outer pressures acting on the coatings. The principal simplifying assumption in the model is that no elastic or creep deformation occurs in the silicon carbide layer; this incurs errors in the results which are typically 1 to 2%. The model is able to deal quantitatively with situations in which the radiation-induced dimensional change rates of the pyrocarbon layers are anisotropic, when they are

a function of neutron dose, and also when they are a function of radial position within a particular layer. The resulting analytical relations enable stresses to be calculated very easily by hand in practical situations. They also demonstrate very clearly the relative importance of the various input variables which are required in the calulation. (19 references) (auth)

Power Reactors, Non-Breeding, Otherwise Moderated

Refer also to abstracts 24929 and 26680.

26509 (AAEC/TM-614) ESTIMATED HEAT OUTPUTS OBTAINABLE FROM SPHERICAL CERAMIC FUEL ELEMENTS IN A PEBBLE BED REACTOR. Whatham, J. F. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Apr 1973. 15p. Dep. NTIS (U. S. Sales Only) $3.00.

Equations for the limiting power density to be expected from a pebble bed reactor core are derived from the results of a series of transient cooling or "quench" tests on unfuelled beryllium oxide balls. The equations are obtained by calculating the thermal stress to cause cracking, and reservations regarding the meaning and validity of the stress value so calculated are discussed. Methods of calculation and graphs to facilitate the procedures are given which enable the allowable average core power density to be estimated in terms of the diameter, surface temperature (up to 1,000°C) and cracking probability of the fuel balls. Two types of spherical fuel elements are considered, a solid ball with a uniform dispersion of fuel particles and a shelled ball consisting of an unfuelled shell and a loose, but concentric, fuelled kernel in which cracking probability then refers to the shell. 7 references. (auth)

26510 (AECL-4223) CYCLING DECONTAMINATION TECHNIQUES AT DOUGLAS POINT GENERATING STATION: THEIR EVOLUTION AND RECOMMENDED PRACTICE. Montford, B. (Atomic Energy of Canada Ltd., Pinawa (Manitoba). Whiteshell Nuclear Research Establishment). Jul 1973. 21p. Dep. NTIS (U. S. Sales Only) $3.25. AECL $0.50.

A study of activity transport at Douglas Point Generating Station was begun in 1971. Initially the objective was to observe radionuclide release to coolant, correlate this with reactor operation, and, if possible, determine the cause of the release. The concentration of radionuclides in the coolant closely followed the crud concentration. The crud concentration during operating periods ranged 0.005–0.020 mg/kg, but could be increased a thousand-fold at shutdown. A temperature cycle alone did not produce a significant crud release during a shutdown. Oxidizing conditions must exist prior to the shutdown and temperature cycle for crud release to occur. Oxidizing conditions prior to the shutdown combined with a temperature cycle offer a viable decontamination procedure at Douglas Point. A change from oxidizing conditions to reducing conditions during the shutdown also causes release of crud. The evolution of the Cycling Techniques is described. 7 references. (auth)

26511 PARTICIPATION OF THE ARGENTINE INDUSTRY IN THE NUCLEAR POWER PLANT AT ATUCHA. Grasso, H.; Quihillalt, O.; Wortman, O. (Comision Nacional de Energia Atomica, Buenos Aires). pp 180-182 of III Interamerican Conference on Materials Technology. Buenos Aires; Centro Regional de Ayuda Tecnica (1972). (In Spanish).

From 3rd inter-American conference on materials technology; Rio de Janeiro, Brazil (14 Aug 1972). See CONF-720832-.

The nuclear power plant at Atucha was constructed on the right bant of the Rio Parana de las Palmas at about 100 km from the city of Buenos Aires. After the feasibility study, the National Atomic Energy Commission placed special emphasis on obtaining maximum participation by local industry for the purpose of making it qualified in the fabrication of components for nuclear power plants. The methodology used that includes technical and economic aspects and the results obtained are described. (tr-auth)

Power Reactors, Breeding

Refer also to abstracts 25041, 25042, 26478, 26600, 26601, 26609, 26614, 26628, 26642, and 26668–26670.

26512 (CONF-721018-27) INTERCOMPARISON OF DIFFERENT METHODS TO CALCULATE NEUTRON TRANSPORT ALONG SODIUM DUCTS. Amin, E.; Hehn, G.; Schmidt, F.; Dietrich, O.; Futtermenger, W.; Vogt, H.; Groenefeld, G.; Vossebrecker, H.; Herrnberger, V. (Stuttgart Univ. (West Germany). Institut fuer Kernenergetik; European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center; Technische Hochschule, Hanover (West Germany). Arbeitsgruppe fuer Bautechnischen Strahlenschutz; Internationale Atomreaktorbau G.M.B.H., Bensberg (West Germany); Eidgenoessisches Institut fuer Reaktorforschung, Wuerenlingen (Switzerland)). 1972. 16p. Dep. NTIS (U.S. Sales Only) $3.00.

From 4th international conference on reactor shielding; Paris, France (9 Oct 1972).

An intercomparison was completed for programs capable of dealing with two-dimensional shielding problems. The programs used are the S_N-program DOT II, the group Monte Carlo programs MORSE-K and TIMOC-71, the point Monte Carlo programs UNC-SAM2 and TRAPAR and a modified diffusion code DLS. The streaming of neutrons along a sodium coolant pipe of a fast breeder reactor was chosen as a test example. The following parameters were considered: axial and radial distribution of fluxes and reaction rates, neutron energy spectra at different penetration depths, and computer time required. (FR)

26513 (CONF-730801-, pp 181-202) EBR-II DRIVER-FUEL QUALIFICATION AND PERFORMANCE. Walter, C. M.; Olson, N. J.; Hofman, G. L. (Argonne National Lab., Idaho Falls, ID). Aug 1973.

From symposium on materials performance in operating nuclear systems; Ames, Iowa, USA (28 Aug 1973).

Two principal driver-fuel-element designs have been irradiated in EBR-II. The Mark-IA design is presently being used as driver fuel and is composed of a cast uranium–5 wt % fissium fuel pin, sodium-bonded to an annealed Type-304L stainless steel jacket. An advanced design for EBR-II driver fuel (Mark-II) uses the same fuel material as the Mark-IA element, but differs in that it employs either an annealed Type-316 or -304L stainless steel cladding, and has a thicker cladding for higher strength, a larger annulus between the fuel and cladding to obtain greater gas release prior to fuel/cladding contact, and a larger plenum to accommodate the greater gas release while maintaining low plenum pressure. Three major areas are explored in this report. (1) The irradiation performance of the Mark-IA and Mark-II designs is summarized. An evaluation of cladding diameter changes produced by stainless steel swelling and plastic deformation, as well as an analysis of cladding failures obtained in run-to-failure experiments, is emphasized. The analysis includes the characterization of cladding failure modes and a statistical treatment of reliability based upon the cladding failures generated in each fuel-element design. (2) These irradiation results are applied to EBR-II core qualification and burnup limits are set based on the reliability required in a given reactor loading. Included is an orderly scheme for generating the required irradiation data for interim and ultimate burnup limits. (3) Some problems encountered with driver-fuel irradiation behavior during reactor operation are summarized. Of particular interest is an anisotropic irradiation-growth phenomenon, which was caused by preferred orientation induced during sodium bonding of the fuel pins to their jackets. 7 figures. (auth)

26514 (EIR-239) MEASUREMENTS OF NEUTRON SPECTRUM AND REACTION RATES IN A GAS-COOLED FAST REACTOR LATTICE. Richmond, R.; Heer, W.; Rueegger, B.; Seth, S.; Steiner, W.; Wydler, P.; Zuercher, W. (Eidgenoessisches Institut fuer Reaktorforschung, Wuerenlingen (Switzerland)). Jul 1973. 62p. Dep. NTIS (U. S. Sales Only) $5.25.

A description is given of the first of a series of measurements of the neutron physics properties of fast reactor lattices which are currently in progress on the zero energy reactor PROTEUS. This is a coupled fast-thermal assembly in which a central fast reactor zone is driven critical by a surrounding thermal zone. The fast zone is large enough to produce, in its central region, a neutron spectrum approximating closely to the equilibrium spectrum. The aim of these measurements is to provide integral data which can be used to check the predictions of nuclear data sets. The first set of measurements was made in a lattice with the composition and geometry characteristic of a typical gas-cooled fast breeder design. An important feature is that the fast zone is entirely in rod form so that neutron streaming and heterogeneity effects are correctly represented. The quantities measured at the center of the fast reactor zone were: neutron spectrum, which was measured by means of the proton recoil technique; the relative values of the fission rates of ^{239}Pu, ^{238}U and ^{235}U in the fuel rods, which were measured by a foil activation method and by the use of solid state track recorders; and the ratio of ^{238}U capture rate to ^{239}Pu fission rate, which was determined relative to the corresponding ratio in a thermal neutron spectrum. 23 references. (auth)

26515 (GEAP-10028-46) SODIUM-COOLED REACTORS CORE ENGINEERING PROGRAM. Forty-sixth Quarterly Report,

February–April 1973. (General Electric Co., Sunnyvale, Calif. Breeder Reactor Dept.). May 1973. Contract AT(04-3)-893. 151p. Dep. NTIS $7.60.

Progress is described for tasks related to fuel rods, fuel rod assemblies, core restraint, control and blanket assemblies, and defected fuel. (auth)

26516 (GEAP-10611) REPORT ON THE STATE-OF-THE ART REVIEW FOR LMFBR SOURCE RANGE FISSION COUNTER. Wimpee, L. C. (General Electric Co., Sunnyvale, Calif. Breeder Reactor Dept.). Jul 1972. Contract AT(04-3)-189. 15p. Dep. NTIS $4.00.

A source range neutron monitoring (SRM) channel for LMFBR requires that low level neutron flux be monitored in the presence of gamma flux levels of approximately 10^6 R/hr and at temperatures of 850°F to 1050°F. At present there are no commercially available components suitable for this channel and thus it is necessary to develop detectors, cables and electronics to provide sustained service under the severe conditions imposed by the LMFBR. Investigations of commercially available components have revealed that existing out-of-vessel detectors are not satisfactory even though external cooling might be provided. In-core SRM detectors used in BWs and PWRs lack the neutron sensitivity and gamma discrimination capability. They are also marginal at the operating temperature of the LMFBR. Typically, maximum temperature catalog ratings of the in-core detectors are 600 to 750°F. (auth)

26517 (GEAP-13822-5) COMPARISON OF ROD- VERSUS SLAB-TYPE CORE NEUTRON SHIELDS FOR LMFBR APPLICATIONS. Final Report, April 1973. Weiss, M. L.; Harless, W. H. (General Electric Co., Sunnyvale, Calif. Breeder Reactor Dept.). May 1973. Contract AT(04-3)-893. 57p. Dep. NTIS $5.00.

The results of experimental and analytical studies on LMFBR in-vessel axial and radial shields are presented. The shielding measurements were performed at the Oak Ridge National Laboratory (ORNL) Tower Shielding Facility during the period June to September 1972. The test configurations were designed and fabricated by General Electric's Nuclear Energy Division based upon types of neutron shields planned for use in an LMFBR demonstration plant. The configurations tested, experiments performed, and the analytical methods are described; and comparisons between measured and calculated results are presented and interpreted. 19 references. (auth)

26518 (GEAP-13944) HIGH-TEMPERATURE STRESS ANALYSIS PROGRAM. Rally, F. C.; Whitling, W. H. (comps.) (General Electric Co., Sunnyvale, Calif. Breeder Reactor Dept.). Apr 1973. Contract AT(04-3)-189. 153p. Dep. NTIS $7.60.

An inelastic analysis was performed on two typical LMFBR components (intermediate heat exchanger inlet nozzle and intermediate heat exchanger tube-sheet-to-shell junction) subjected to typical thermal transients in combination with primary stresses using the CREEP PLAST computer program. It was concluded that both these austenitic stainless steel components operating at 1000°F met the ASME Code Case 1331-7 criteria by significant margins. Generalized conclusions relative to expected response of LMFBR components and suggested approaches to inelastic analysis are given. Suggestions for future work are also included. 7 references. (auth)

26519 (GEAP-13966) GRID BEAM TAB DISLODGMENT TESTS. Feerick, B. T.; Tullbane, P. D. (General Electric Co., Sunnyvale, Calif. Breeder Reactor Dept.). May 1973. Contract AT(04-3)-893. 29p. AT.

The GE-BRD grid-spaced fuel assembly concept maintains the grid beam spacer position within the hexagonal channel by mechanical fit of the beam tabs into channel recesses. Forces exerted by friction between the fuel rods and the grid spacers due to initial loading operations or reactor operating conditions act to disengage the beam tabs from the channel recesses. The grid beam tab design is selected to provide suitable design margins against spacer dislodgment. The reference design has been improved based on a series of mechanical dislodgment tests that showed the sensitivity of the design to tab features. The experimental results indicated that a greater tab height and a radiused tab significantly increased the disengagement resistance over earlier tab designs utilized during the conceptual design stage of the grid assembly. The first result is attributed to an increased moment of inertia. The second result is caused by having the tab fail in a buckling mode rather than a twisting bending mode characteristic of the earlier designs. (auth)

26520 (ORNL-TM-4039) FAST REACTOR EXPERIMENTAL SHIELDING MONTHLY PROGRESS REPORT FOR AUGUST AND SEPTEMBER 1972. 189A No. 10028, Activity No. 40 01 03 1. Clifford, C. E.; Muckenthaler, F. J.; Stevens, P. N. (Oak Ridge National Lab., Tenn.). Nov 1972. Contract W-7405-eng-26. 98p. AT.

The progress made by the ORNL Neutron Physics Division in Fast Reactor Experimental Shielding Research during the months of August and September. Results are presented for the General Electric demonstration plant shielding experiment. Neutron spectra and fluences were measured beyond shielding configurations consisting of boron-carbide-filled stainless steel tubes of 1-, 2-, and 5.4-in. diam. in close packed arrays, each array having tubes of only one diameter. The purpose was to study streaming effects caused by the presence of a relatively ineffective neutron shield (aluminum) between the tubes, and also to provide a benchmark experiment for neutron transport in boron carbide. Measured neutron spectra transmitted by 18-in. stainless steel, 6-in. sodium, and 1-in. boral are also presented. (auth)

26521 (WARD-SS-3045-2) RADIAL BLANKET AND SHIELD SIMULATION EXPERIMENTS. Quarterly Progress Report for Period Ending July 31, 1973. Rittenberger, R. V. (Westinghouse Electric Corp., Madison, PA. Advanced Reactors Div.). Sep 1973. Contract AT(11-1)-3045. 36p. AT.

Progress in research on shielding and radial blanket requirements for LMFBR's is reported. Work during the period consisted of experimental measurements for the final six configurations and analytical analyses of the configurations. (JNR)

26522 (WASH-1201) LMFBR DEMONSTRATION PLANT PROGRAM. Proceedings of Senior Utility Steering Committee and Senior Utility Technical Advisory Panel for the Period April 1971 thru January 1972. (Atomic Energy Commission, Washington, D. C.). Mar 1972. 570p. Dep. NTIS $30.50.

26523 FUEL ELEMENT FOR FAST REACTORS WITH A DEVICE FOR EXHAUSTING THE FISSION GASES THEREFROM. Gerosa, A.; Martini, M. (to Comitato Nazionale per l'Energia Nucleare). U. S. Patent 3,748,230. 24 Jul 1973. Priority date 20 Aug 1968, Italy. 6p.

The invention provides a means for exhausting the fission gases from the rods of a nuclear reactor fuel element while preventing the coolant from reaching the inside of the rods on any transient conditions of the reactor. The means comprises a vertically elongated chamber which is superimposed to the fuel element and is sealed at its top and side walls, a series of apertures being provided only at the lower section of it at a short distance from the top end of the fuel element rods which apertures communicate the inside of the chamber with the surrounding space where the coolant stream of the reactor flows upwards. Each fuel rod is provided with a very thin tube connecting the top section of the rod with the top section of the chamber, the profile of the side wall of the latter may be chosen in such a way that a suction is applied to the apertures by the coolant stream which partially compensates for any increase of pressure on the same apertures due to an increase of frictional losses downstream of the chamber whenever there is an increase of the flow speed of the coolant. (Official Gazette)

26524 CONTAINMENT SYSTEM FOR A SODIUM COOLED REACTOR. Hillekum, H.; Lange, L. (to Interatom Internationale Atomreaktorbau GmbH). U. S. Patent 3,748,227. 24 Jul 1973. Priority date 24 Oct 1970, F. R. Germany. 6p.

A containment system is provided for a sodium cooled reactor having a heat removal system for removing heat energy generated in the reactor during normal operation. The containment system limits the effects of a Bethe-Tait excursion and heat energy released and prevents the transmission of dangerous radiation to the environment in the event of an accident in the reactor. The containment system has three mutually telescoped containment shells of concrete surrounding the reactor, the shells being formed respectively of flat rectangular walls and a flat rectangular ceiling. A pressure relief compartment is disposed within the innermost of the shells and a heat sink is located in the compartment with a heat absorbing capacity adequate for absorbing the heat energy released by the reactor in the event of an accident as well as for absorbing the heat energy present during a simultaneous failure of the heat removal system. The innermost shell is resistant to pressure and is at least partially penetrable by gas. (Official Gazette)

26525 PROBABILISTIC METHOD FOR IDENTIFYING FAILED FUEL ELEMENTS USING A GAS TAG SYSTEM. Schmittroth, F. (Westinghouse Hanford Co., Richland, WA). Nucl. Sci. Eng.; 52: No. 1, 95-106 (Sep 1973).

A formalism is developed for full exploitation of a gas tag system used for locating failed fuel elements in fast reactors. Based on the measured gas tag ratios detected in an actual failure, the method assigns quantitative probabilities to the various combinations of failures which can occur. Both the failure of a single fuel element and the simultaneous failure of two elements are treated in detail. (auth)

26526 UK VIEW ON FAST REACTORS. Marsham, T. N. (United Kingdom Atomic Energy Authority, Dounreay, Scotland). Atom (London); No. 201, 150-163(Jul 1973).

The fast reactor project is reviewed under the following headings: The UK-US position; the UK fast reactor programme; the Dounreay fast reactor (DFR); the prototype fast reactor (PFR); the commercial fast reactor (CFR); and economics. (UK)

Research, Test, and Experimental Reactors

Refer also to abstracts 24934, 25202, 25318, 26513, 26515, 26526, 26661, and 26671.

26527 (AEEW-R-880) COMPUTER-CONTROLLED NEUTRON FLUX SCANNING DEVICE FOR USE IN ZERO POWER REACTORS. Batt, R.; Hilton, R. K.; Ingram, G.; Jamieson, G. R.; Jowitt, D.; Keats, A. B.; Marshall, J.; Schwenk, A. B. (Atomic Energy Establishment, Winfrith (England)). Dec 1972. 32p. Dep. NTIS (U. S. Sales Only) $3.75.

A novel type of flux scanning machine for use on zero power reactor systems is described. Its virtues are compactness, accuracy of probe positioning, scanning range of at least 6.5 m, computer control and cheapness (less than £5,000)). It has eliminated many of the difficulties formerly associated with the use of lead-screw type flux scanners such as unwieldiness and inaccuracies arising from re-positioning, and operating experience to date suggests that it will enable more accurate and versatile flux plots to be obtained. 3 references. (auth)

26528 (BARC/I-179) STRESS ANALYSIS OF REFLECTOR-TO-PROPELLER ARM JOINT FOR PFR ROTOR. Kakodkar, A. (Bhabha Atomic Research Centre, Bombay (India)). 1972. 48p. INIS.

Stress analysis of the joint between the reflector block and the propeller arm of the pulsed Fast Reactor being set up at Kalpakkam, Madras, has been carried out using a photoelastic model. The geometrical details of the model are given. Titanium alloy (6%Al–4% V–Ti) has been selected as material for the propeller because of its high strength to weight ratio, good ductility and low activation under irradiation. For similar reasons the keys would be made of high strength steel and the reflector block of beryllium. The photoelastic analysis has been done using a Zeiss polariscope. The isoclinic angles and the fringe orders have been determined at the points of interest. Maximum stresses have been calculated in the keys, the moving reflector and the rotor fixation region for a speed of 3000 rpm. It is concluded that the joint would be safe even if one of the keys fails. Safety factors at 3000 rpm are given and compared with those for SORA design. (INIS)

26529 (CONF-730801-, pp 41-58) BERYLLIUM REFLECTOR CRACKING AT THE ADVANCED TEST REACTOR. Smith, E. H.; Liebenthal, J. L.; Winkel, B. V.; Beeston, J. M.; Francis, W. C. (Aerojet Nuclear Co., Idaho Falls, ID). Aug 1973.

From symposium on materials performance in operating nuclear systems; Ames, Iowa, USA (28 Aug 1973).

Initial cracking of the ATR reflector occurred during reactor Cycle 11D after 113,593 MWd. The peak fluence at the crack was 1.0×10^{22} n/cm^2 (E > 1 MeV). Cracking was observed during fuel element inspection from a strain pattern which ran the full length of the fuel plates facing the beryllium. Inspection of the reflector face adjacent to the fuel positions revealed vertical cracks running the length of three of the eight blocks, and minor cracks in two other blocks. The primary cracks appeared to initiate at the top or bottom, where the width of the cracks was 30 to 60 mils. Photographs of four observable joints between adjacent blocks were taken. The as-installed gap of each joint the beryllium pieces and two were closed over the middle one-third of the height of the beryllium pieces. The reflector narrows to a "tapered" edge at eight positions adjacent to other reactor components. In three positions, the tapered edge touched the component at the reactor midplane. Stress analysis revealed that large bending stresses exist in the area where cracking occurred. Operation of the ATR with the cracked ligaments was effected after several fixes: (1) pins were placed in the beryllium blocks, which reduced stresses in ligaments with the highest stress, (2) flow restrictors were placed in the large holes of the beryllium to reduce pressure loads on the stressed ligaments, and (3) undesirable cracking was prevented by introducing controlled cracks through scribing of the remaining five blocks. Operation of the ATR to 32,000 MWd beyond the start of cracking has resulted in only minor additional cracking. (auth)

26530 (CONF-730801-, pp 153-165) BOWING OF AN OAK RIDGE RESEARCH REACTOR COMPONENT. Farrell, K.; King, R. T.; Jostsons, A.; Long, E. L. Jr. (Oak Ridge National Lab., TN). Aug 1973.

From symposium on materials performance in operating nuclear systems; Ames, Iowa, USA (28 Aug 1973).

A straight, elongated tray built from recrystallized 1100 grade aluminum was irradiated in contact with cooling water at about 45°C to thermal and fast neutron fluences up to 3×10^{22} n/cm^2. It bowed to a banana-like shape. Investigation demonstrated that the fast neutron fluence profile along the length of the tray had the same form as the measured bowing deflection, suggesting an association of bowing with displacement damage. Transmission electron microscopy revealed a nonuniform distribution of radiation-induced voids and transmutation-produced silicon precipitate along the length of the tray, the volume of voids increasing with fast fluence and being greatest at the positions of maximum fast neutron flux and maximum curvature. Density measurements were used to determine the variation of swelling along the length of the tray from which it was shown that swelling was unequal across opposite sides of the tray. Calculations of length changes based on these data showed excellent agreement with the bowing deflections, confirming that bowing was caused by the nonuniform distribution of voids created by fast neutron damage. 9 figures, 3 tables. (auth)

26531 (CONF-730801-, pp 166-180) EXPERIENCE WITH STRESS-CORROSION CRACKING AND MATERIALS COMPATIBILITY AT THE HIGH FLUX BEAM REACTOR. Powell, R. W.; Chow, J. G. Y.; Brynda, W. J.; Brooks, M. H.; Weeks, J. R. (Brookhaven National Lab., Upton, NY). Aug 1973.

From symposium on materials performance in operating nuclear systems; Ames, Iowa, USA (28 Aug 1973).

The primary system components of the High Flux Beam Reactor are fabricated from aluminum 6061 and type 304 stainless steel. An 18-inch dia stainless steel weld-neck flange, which was a component of the primary coolant system piping, failed due to intergranular stress corrosion cracking. Stress analyses showed that hoop stresses due to high bolt tension were sufficient, when coupled with other circumstances, to be of significance. Detailed metallurgical analyses of some of the cracks which were removed from the pipe identified the cracks as intergranular which originated from the inside surface. The cracks seemed to originate in the heat affected zone but none extended into the weld material. The replacement flange, of the stub end type, was not subject to hoop stresses existing in the weld neck type. 7 figures. (auth)

26532 (EUR-4954, pp 297-372) SUMMARY OF SORA PROJECT REPORT. (EURATOM, Ispra, Italy). Apr 1973.

From joint meeting on pulsed neutrons and their utilization; Ispra, Italy (17 Sep 1971).

The concept and design of the SORA periodically-pulsed reactor have been developed over the years by the Joint Research Centre, Ispra. In mid-1971 a design study was started with a Consortium of five European companies in order to arrive at a fixed-price offer for the reactor installation. This study was terminated in mid-1972. A short summary of the design that emerged from the study is presented. It is based on the technical dossiers of the industrial consortium and on the parallel work done by the Joint Research Centre, mostly in the fields of reactor physics, dynamics and safety. The reactor components, cooling systems, control and instrumentation, and handling and storage systems are described. (EU)

26533 (EUR-4954, pp 375-424) SORA PROGRAM. Kley, W. (EURATOM, Ispra, Italy). Apr 1973.

From joint meeting on pulsed neutrons and their utilization; Ispra, Italy (17 Sep 1971).

Most of the guiding principles that have been used for the Conceptional Design of the SORA-reactor for physics experiments are presented. The conceptional design is given for: the neutron moderators, the beam tubes, the time of flight spectrometers using neutron guide tubes for the production of "quasi-monochromatic" neutron beams, the application of the statistical chopper for monochromatic and "quasi-monochromatic" neutron spectrometers, the fast neutron irradiation facilities, the production of fission fragment beams for the study of the fast fission processes and delayed neutron emitters, the application of neutron beams for samples under extreme conditions and the production of high ultra cold neutron peak flux. (EU)

26534 (EUR-4954, pp 427-450) MODERATOR STUDIES FOR THE SORA REACTOR. Riccobono, G.; Ardente, V.; Rossi, G. (EURATOM-CCR, Ispra, Italy). Apr 1973.

From joint meeting on pulsed neutrons and their utilization; Ispra, Italy (17 Sep 1971).

The guidelines which have led to the choice of the moderator materials are given and their relative merits with respect to the

requirements of the instrumentation which they should illuminate are compared. (EU)

26535 (EUR-4954, pp 453-480) THERMAL AND EPITHERMAL SOURCES IN SORA. Asaoka, T.; Rief, H. (EURATOM, Ispra, Italy). Apr 1973.

From joint meeting on pulsed neutrons and their utilization; Ispra, Italy (17 Sep 1971).

In the SORA reactor, a certain number of the neutrons produced in periodic pulses in the fast core are converted in hydrogenous moderators into pulsed beams of low-energy neutrons for time-of-flight measurements. For most of the experiments around pulsed reactors these moderators are the main sources of neutrons. Parametric studies have been performed for different moderator materials and dimensions for re-entrant hole geometries, and for homogeneous and heterogeneous poisoning. Absolute flux values and their time dependent pulse shape were calculated —using the 1 MW version of SORA—for the more interesting configurations resulting from the parametric study. The different possibilities are compared with each other by "figures of merit". In order to show the development potential of SORA and pulsed reactors in general the list of absolute flux values was extended to a SORA reactor of 3 MW power and an accelerator pulsed version of 1 MW. The results only are discussed, without a description of the methods used, to which insufficient reference will be made. (EU)

26536 (GEAP-13947) SODIUM FLOW ENDURANCE TEST OF 37 ROD GRID-SPACED ASSEMBLIES. Meserve, C. E. (General Electric Co., Sunnyvale, Calif. Breeder Reactor Dept.). May 1973. Contract AT(04-3)-893. 39p. AT.

Two 37-rod assemblies containing an FTR grid spacer design, similar to the F9E assembly now undergoing irradiation in EBR-II, were subjected to a prototypic sodium environment for six months in the Control Drive Test Loop at General Electric's Breeder Test Facility in San Jose. The main objectives of this endurance test were to determine the effect of long term exposure to high temperature, flowing sodium on the structural integrity of the grid spacers, the adequacy of the grid spacer tabs to remain locked in the channel pockets, the fuel rod to grid spacer wearing surface, and the relative merits of a staggered grid design versus a full grid design. The structural integrity of both the staggered and full grid spacers was demonstrated. No dislodgement of spacer tabs from their respective channel recesses occurred during the flow test; the dislodgements that were observed occurred during final assembly. Fretting and wear resulting from flow-induced vibrations were insignificant and marked by galling that occurred during assembly and disassembly. The staggered grid spacer assembly exhibited superior resistance to grid dislodgement and lower rod friction forces than the full grid assembly. (auth)

26537 (GEAP-13964) SPECIFICATION OF ZPPR ASSEMBLY 3, PHASES 2 AND 3 EXPERIMENTAL PROGRAM. Stewart, S. L. (General Electric Co., Sunnyvale, Calif. Breeder Reactor Dept.). Jun 1973. Contract AT(04-3)-893. 39p. Dep. NTIS $4.00.

The final specifications that were developed for Phase 2 and Phase 3 of the ZPPR-3 Demonstration Plant Benchmark Critical Experiment Program are described. The specifications for Phases 1A and 1B are reviewed to show the overall experimental program. Experimental results have been reported in ANL monthly reports. Analysis of experimental and analytical results will be documented in a subsequent topical report. (auth)

26538 (ORNL-TM-4315) OAK RIDGE RESEARCH REACTOR QUARTERLY REPORT, JANUARY, FEBRUARY, AND MARCH OF 1973. Hurt, S. S. III; Lance, E. D. (Oak Ridge National Lab., Tenn.). Sep 1973. Contract W-7405-eng-26. 46p. Dep. NTIS $4.50.

The ORR operated at an average power level of 29.9 MW for 89.3% of the time during January, February, and March of 1973. Thirty-seven fuel elements were declared spent with an average burnup of 47.2%, and two shim-rod elements were retired from service at an average burnup of 90.1%. The reactor was shut down on eight occasions, all of which were scheduled. End-of-cycle shutdowns accounted for 91.3% of the total downtime, with the remainder used principally for refueling and experiment work. Maintenance activities, both mechanical and instrument, were essentially routine in nature. The reactivity worths of the shim rods were measured because of a change in the schedule for shim-rod utilization. (auth)

26539 25 keV NEUTRON BEAM FACILITY AT THE REACTOR APSARA. Kondaiah, E.; Anand, R. P.; Bhattacharya, D. (Tata Inst. of Fundamental Research, Bombay). Nucl. Instrum. Methods; 111: No. 2, 337-343(1973).

A monoenergetic neutron beam of 25 keV energy with an energy spread of less than 5 keV has been obtained at the swimming-pool type reactor "Apsara" using a filter assembly consisting of iron, aluminum and sulphur. The filtered beam characteristics have been studied for various compositions of the filter assembly and for various positions of the filter in beam hole No. 2. The 25 keV neutron flux was measured as $(1.5 \pm 0.05) \times 10^4$ neutrons/cm^2 s when the reactor was operating at 400 kW. The contamination due to neutrons of energy greater than 25 keV is found to be less than 2% of the 25 keV neutron flux. The gamma dose in front of the filter assembly is found to be ≈ 25 mR/h. 12 references. (auth)

26540 STUDY OF NEUTRON WAVE PROPAGATION THROUGH A SUBCRITICAL ASSEMBLY. Sobhana, S.; Goyal, I. C.; Singh, O. P.; Ghatak, A. K. (Indian Inst. of Tech., New Delhi). J. Nucl. Energy; 27: No. 7, 441-447(Jul 1973).

Results of a series of calculations on the propagation of neutron waves in multiplying media using multigroup diffusion theory are reported. For a heavy-water natural uranium subcritical assembly (taking into account the slowing down of fission neutrons), the variation of the attenuation constant α and phase lag ξ with frequency have been studied and compared with the available experimental data. It is found that the multigroup theory gives satisfactory agreement with experimental data. The striking feature of the multigroup theory is that it gives the correct frequency dependence of α and ξ, not only at low frequencies but also at high frequencies. On the other hand, the two group theory results totally fail at high frequencies. The multigroup theory is also better than the Fermi-age theory because the latter, though giving a correct behavior of the dispersion curve, shows a general disagreement with the experimental data for all frequencies. (auth)

Production and Materials Testing and Processing Reactors

Refer also to abstracts 25201 and 26672.

26541 (DUN-7627) COMPUTER PROGRAM ANALYSIS OF HANFORD NUCLEAR PLANT SYSTEMS DATA. Crosetti, P. A.; Vollmer, G. E. (Douglas United Nuclear, Inc., Richland, Wash.). 30 Apr 1971. 28p. Dep. NTIS $3.50.

The DATANL program for the recording, checking, handling, and utilization of test and inspection data on the plant protective systems at the Hanford reactor complex is described. The program is designed to provide a continuously improving data bank for use in generating reliability data and in monitoring equipment performance trends. The program has three versions and is designed for the UNIVAC 1108 computer. (JWR)

26542 (HW-57041) 100-N DESIGN BASES. Part V. Functional Requirements of the Plant Auxiliary Control and Instrumentation Systems. Project CAI-816. Condotta, D. L. (General Electric Co., Richland, Wash. Hanford Atomic Products Operation). 24 Aug 1959. 32p. Dep. NTIS $3.75.

Declassified 4 Apr 1973.

Design bases outlining the functional requirements of the instrumentation and control systems for a number of the auxiliary components of the N production reactor are presented. (JWR)

26543 (HW-57043) 100-N DESIGN BASES. Part I. General. Project CAI-816. Astley, E. R.; Locke, G. L. (General Electric Co., Richland, Wash. Hanford Atomic Products Operation). 17 Mar 1959. 33p. Dep. NTIS $3.75.

Declassified 4 Apr 1973.

The objectives and requirements for the design of the N production reactor are summarized.

26544 (HW-57759) AUTOMATIC COMPENSATION FOR GRAPHITE CONTRACTION IN THE NPR AND OTHER GRAPHITE MODERATED REACTORS. Haugland, G. T. (General Electric Co., Richland, Wash. Hanford Atomic Products Operation). 10 Oct 1958. Contract AT(45-1)-1350. 18p.

Declassified 4 Apr 1973.

The contraction wedge and thermal expansion wedge concepts for eliminating or reducing graphite contraction problems in the Hanford N Reactor or other graphite reactors are described. (JWR)

26545 (HW-66825) TECHNICAL BASES FOR REVISION OF THE EMERGENCY COOLING SYSTEM INSTRUMENTATION. Mollerus, F. J. Jr. (General Electric Co., Richland, Wash. Hanford Atomic Products Operation). 28 Sep 1960. Contract W-31-109-Eng-52. 9p. Dep. NTIS $3.00.

Declassified 4 Apr 1973.

Information on instrumentation changes for actuation of the emergency cooling system at the Hanford N Reactor is presented. (JWR)

26546 (HW-72546) DIFFUSION OF WATER VAPOR THROUGH NPR CORE GRAPHITE. Shannon, D. W. (General Electric Co., Richland, Wash. Hanford Atomic Products Operation). Feb 1962. Contract AT(45-1)-1350. 50p. Dep. NTIS $4.50.

Declassified 4 Apr 1973.

Of the various contaminants present in the helium gas to be used in the NPR, hydrogen is the most potentially serious to the Zircaloy-2 process tubes. Water vapor is known to be a powerful inhibitor of zirconium hydriding, but to be effective, the water vapor must diffuse from the bulk gas through the graphite tube block to the process tube. The diffusion of water vapor through NPR core graphite was measured over a temperature range of 400 to 800°C and a water partial pressure of 0.05 to 1 mm. Effective diffusion coefficients were calculated from the data to be in the range of 0.03 to 0.1 cm^2/sec. The measured results were extrapolated to a full size NPR tube block and the required dewpoints were calculated from Zircaloy oxidation requirements. The effect of CO, CO_2, and H_2 additions (on H_2O transport) was determined, but only CO–H_2-mixtures were found to assist in maintaining these dewpoints. (auth)

26547 (HW-72696) LATTICE PARAMETER MEASUREMENTS FOR N REACTOR. Johnson, D. L.; Endres, G. W. R.; Birney, K. R.; Wood, D. E.; Block, E. Z. (General Electric Co., Richland, Wash. Hanford Atomic Products Operation). Nov 1963. Contract AT(45-1)-1350. 68p. Dep. NTIS $5.50.

Declassified 4 Apr 1973.

Lattice parameters for the concentric-tube N-Reactor fuel element have been measured in the Physical Constants Test Reactor (PCTR) and in the two exponential piles. The measurements were performed in two lattices: a mockup of the actual N-Reactor lattice and a lattice having the same amount of graphite but without the steam vents present in the N-Reactor lattice. The PCTR measurements reported include k_∞, f, and ϵ for both lattices with water and air in the coolant channels. In addition, k_∞ and f were measured in the mockup with intermediate coolant water densities to simulate both the reduction in density at high temperature and partial boil-out. The exponential experiments reported include the material buckling for both lattices with either water or air in the coolant channels and, in addition, the material buckling and control rod strength for different amounts of flooding in the water-cooled mockup lattice. Several supplementary studies are included such as flux peaking near a fuel end-cap and cell traverses of gold and depleted uranium. (auth)

Propulsion and Package Reactors

Refer also to abstracts 24426, 24937–24945, 25239, and 26604.

26548 (LA-2430) POST-MORTEM EXAMINATION OF KIWI-A. MacMillan, D. P.; Driesner, A. R. (Los Alamos Scientific Lab., N. Mex.). Jul 1960. Contract W-7405-eng-36. 115p. Dep. NTIS $7.75.

Declassified 28 Aug 1973.

A brief account is given of the disassembly of Kiwi-A, the first rocket reactor test device to be tested at Nevada Test Site on July 1, 1959. The results of examination of some recovered parts, particularly the fuel elements, are presented. Some of the "graphite whims" supporting the fuel elements were found to be cracked. Rupture of the closure plate was verified. The consequent by-pass of propellant resulted in much higher fuel element temperatures than planned with consequent severe corrosion of the hotter fuel elements. Fuel plates were examined radiographically and autoradiographically, dimensional and weight changes were measured, and photographs were taken. From these data together with studies of graphite corrosion as a function of temperature in an electrically heated furnace, the temperature from point to point in the reactor was deduced and an estimate made of propellant by-pass. (auth)

26549 (LA-2680) ASPEN II: TWO-STAGING AND RADIATION SHIELDING EFFECTS ON ASPEN VEHICLE PERFORMANCE. Bussard, R. W. (Los Alamos Scientific Lab., N. Mex.). Mar 1962. Contract W-7405-eng-36. 71p. Dep. NTIS $5.75.

Declassified 28 Aug 1973.

An analysis is presented of the potential performance capabilities of several types of manned, two-stage, aerospace planes (ASPEN-II) utilizing nuclear rocket engines for final boost flight into orbit. Comparison is made among the types studied and with single-stage nuclear (ASPEN-I) and chemically powered aerospace planes. In addition, an assessment is made of shield requirements for protection against all of the principal nuclear radiation sources associated with the use of nuclear rocket boosting in either ASPEN-I or ASPEN-II. A discussion is given of shield influence on vehicle payload performance, and some possible methods of reducing shield requirements are indicated. Finally, a simple economic analysis is presented in order to show the potentialities of use of ASPEN vehicles for earth-to-orbit ferry missions. (auth)

26550 (LA-3131-MS) KIWI-B-1B REACTOR EXPERIMENT. Final Test Report. Brown, D. W. (comp.) (Los Alamos Scientific Lab., N. Mex.). Nov 1963. Contract W-7405-eng-36. 250p. Dep. NTIS $14.75.

Declassified 28 Aug 1973.

The results and detailed analyses of the Kiwi-B-1B full-power experiment are reported. Information is given on the thermal performance of the reactor (core, reflector and nozzle) as well as an analysis of the core damage picture based on a detailed post-run examination. Background information is also supplied describing the reactor, test objectives, planned experimental operation and actual experimental operation, in addition to comparisons with the Kiwi-B-1A experiment. (auth)

26551 (LA-3153) FABRICATION OF KIWI WRAPPERS. Kirby, R. S. (Los Alamos Scientific Lab., N. Mex.). 1 Sep 1964. Contract W-7405-eng-36. 41p. Dep. NTIS $4.25.

Declassified 28 Aug 1973.

A satisfactory procedure has been developed for fabricating 50.710 inch long wrapper panels from 0.005 inch thick Invar-36 sheet. The panels were formed by stamping convolutions in 0.005 inch Invar-36 sheet, using a stamping die with steel forming inserts. The stamped panels were then trimmed to length and slit to the final configuration. The final panel sections were fitted together to form the complete wrapper. 4 references. (auth)

26552 (LA-3170-MS) THERMAL ANALYSIS OF THE KIWI-B-4D REACTOR. Parts I–V. McClary, J.; Rhodes, C.; Gido, R.; Holman, R.; Payne, J.; Pitschke, R. (Los Alamos Scientific Lab., N. Mex.). Nov 1964. Contract W-7405-eng-36. 367p. Dep. NTIS $20.50.

Declassified 28 Aug 1973.

Performance predictions of temperature, flow, and pressure distributions for the Kiwi-B-4D-202 and subsequent, similar reactor systems are reported. The analytical techniques and procedures are presented. The procedure for design analysis and resulting specifications for core fuel element and flow meter assembly are also reported. (auth)

26553 (LA-3284) INVESTIGATION OF COUPLED PHOEBUS CORES. Seale, R. L. (Los Alamos Scientific Lab., N. Mex.). Dec 1964. Contract W-7405-eng-36. 42p. Dep. NTIS $4.25.

Declassified 29 Aug 1973.

The analysis of the effect of neutronic interaction on the behavior of the cores in a 15-foot-square array of Phoebus reactors is presented. For adjacent cores, the coupling coefficient is determined to be about 0.5¢, and the coupling time lag is 1.62×10^{-4} seconds. The relative power generated in the cores of the array is evaluated as a function of the reactivity settings in the individual cores. The relative power generated in a single, shutdown core (~5 dollar shutdown margin) due to neutronic interaction with the other cores of the array as they operate at full power is less than 1% of full power. The power density asymmetry within a single core due to the incidence of neutrons from other cores in the array is also less than 1%. The transfer functions of each core in the array have been evaluated at levels from zero power up to full power (5000 MW) with appropriate temperature coefficient and reciprocal thermal time constants for the cores. 6 references. (auth)

26554 (LA-3290) RADIOCHEMICAL MEASUREMENTS ON KIWI-TNT. Bryant, E. A.; Sattizahn, J. E.; Wagner, G. F. (Los Alamos Scientific Lab., N. Mex.). May 1965. Contract W-7405-eng-36. 42p. Dep. NTIS $4.25.

Declassified 29 Aug 1973.

The techniques and results of radiochemical measurements associated with the TNT test of January 12, 1965 are presented. Information is given on total fissions produced, radial and axial distribution of fissions within the core, and fraction of the fissions released to the cloud. (auth)

26555 (LA-3299) SUMMARY OF DISASSEMBLY AND POST-MORTEM VISUAL OBSERVATIONS OF THE KIWI-B4E-301 REACTOR. Driesner, A. R. (Los Alamos Scientific Lab., N. Mex.). 16 Apr 1965. Contract W-7405-eng-36. 37p. Dep. NTIS $4.00.

Declassified 28 Aug 1973.

The Kiwi-B4E-301 reactor was tested approximately 8 minutes at full power (maximum average fuel element temperature approximately 2100°C) on August 28, 1964. The reactor was restarted on September 10, 1964, and run at full power for 2-½ minutes. Test results and disassembly procedures are presented. (auth)

26556 (LA-3311) SURVEY DESCRIPTION OF THE DESIGN AND TESTING OF KIWI-B-4E-301 PROPULSION REACTOR. Zeigner, V. L. (comp.) (Los Alamos Scientific Lab., N. Mex.). May 1965. Contract W-7405-eng-36. 41p. Dep. NTIS $4.25.
Declassified 29 Aug 1973.

The experimental rocket propulsion reactor Kiwi-B-4E-301 was tested at power on August 28 and September 10, 1964. In the first of the two tests the reactor was held at nominal full power for approximately 8 minutes before the available liquid hydrogen supply required shutdown. Peak power achieved during this period was approximately 907 MW (calculated thermal) with a calculated average fuel exit temperature of 4040°R. The reactor was restarted on September 10, 1964, and operated at full power for 2-½ minutes. All of the primary objectives were successfully accomplished in these two tests. No significant malfunctions were observed in any of the components or systems during the tests. Visual inspection of components and core elements at disassembly showed them to be in good condition. There were areas of local corrosion and a small number of broken fuel elements, but from all indications the reactor could have operated for a considerably longer time. (auth)

26557 (LA-3327) SOME NEUTRONIC RESULTS OF THE KIWI-B 4E NEVADA TEST. Plassmann, E. A.; Helmick, H. H.; Orndoff, J. D. (Los Alamos Scientific Lab., N. Mex.). May 1965. Contract W-7405-eng-36. 43p. Dep. NTIS $4.25.
Declassified 29 Aug 1973.

A combination of experimental and calculational techniques have been used to establish, in the Kiwi-B-4E reactor, a final fission distribution which results in power generation radially flat within acceptable limits. Factors involving differential uranium loading, temperature, propellant hydrogen distribution, and control rod perturbations all contribute, their effects being limited generally to the outer few inches of core periphery. DTK (one-dimensional) and DDK (two-dimensional) transport equation computer codes are employed to good advantage in determining temperature and hydrogen effects, while fission chamber and autoradiographic measurements in a zero-power critical assembly mockup provide the basic empirical data needed for the predictions. Also associated with the above factors are reactivity coefficients which become important as the reactor is brought from ambient to operating conditions. The pre-run predictions are evaluated by comparison with measurements made during and after the August, 1964, full-power run at NRDS. The reactivity contributions of temperature change and propellant hydrogen have canceling effects, leading to the rather small decrease of only 20 cents reactivity actually observed. In addition, a deliberate step change in hydrogen density at constant reactor temperature allowed a direct measurement of hydrogen worth. (auth)

26558 (LA-3375) PHOEBUS-1A. Preliminary Report. Elder, M. (comp. and ed.) (Los Alamos Scientific Lab., N. Mex.). 25 Sep 1965. Contract W-7405-eng-36. 137p. Dep. NTIS $9.00.
Declassified 28 Aug 1973.

The Phoebus-1A full power test was conducted on June 25, 1965, at the Nuclear Rocket Development Station, Jackass Flats, Nevada. The reactor was held at full design power and temperature for approximately 10 minutes and 30 seconds before an unexpected loss of coolant resulted in core support overheating and subsequent ejection of core parts through the nozzle. Peak power achieved during the hold was 1090 MW at a maximum fuel element exit temperature of 4460°R. Corresponding values for the Kiwi-B-4E test were 890 MW and 4040°R. The reactor contained several optional design modifications aimed at reducing corrosion. The primary objective of the test series was to operate the reactor at full power and temperature for sufficient cumulative time (>10 minutes) to provide a comparison of these modifications by post-mortem inspection and analysis. Test results are presented. (auth)

26559 (LA-3441) QUARTERLY STATUS REPORT OF LASL ROVER PROGRAM FOR PERIOD ENDING NOVEMBER 30, 1965. (Los Alamos Scientific Lab., N. Mex.). Dec 1965. Contract W-7405-eng-36. 172p. Dep. NTIS $10.75.
Declassified 28 Aug 1973.

Information is presented concerning Phoebus-1A full power test, Phoebus-1B design parameters and neutronics, Phoebus-2 design parameters and neutronics, test facilities, and mechanical properties and fabrication procedures for graphite. (DCC)

26560 (LA-3477) FRAGMENTATION STUDIES OF ONE-INCH ROVER FUEL ELEMENTS. Schulte, H. F.; Campbell, E. E.; Ide, H. M.; Moss, W. D.; Lindsey, J. E.; Reithel, R. J. (Los Alamos Scientific Lab., N. Mex.). 1 Feb 1966. Contract W-7405-eng-36. 94p. Dep. NTIS $6.75.
Declassified 28 Aug 1973.

One-inch sections of Rover fuel elements were fragmented by an axial explosive (PETN). The fragmentations were carried out under four sets of conditions: (1) ambient temperature; (2) heated to 2500°C for three minutes and fragmented hot; (3) preheated to 2500°C for 30 or 180 minutes and fragmented at ambient temperature; and (4) same as (3) except fragmented after reheating to 2500°C. All elements fragmented while hot produced larger particles than those fragmented at ambient temperature. While the particle size distribution profile in each case was similar, sufficient evidence is presented to illustrate the effect of heating on fragmentation. The uranium distribution was markedly affected by heating and the distribution of uranium in particles below the fuel core size was increased in all cases. Fuel core particles remained intact with and without their cladding in the ambient temperature fragmentation study. In the heated fragmentation the uranium was dispersed from the pyrocarbon cladded fuel cores. Diffusion of uranium during preheating was proportional to the length of the preheating period. The mode of fabrication affected the particle distribution profile. A comparison is given between the beaded fuel element and the homogeneous uranium–graphite element. (45 figures, 25 tables) (auth)

26561 (LA-3829) PHOEBUS 1B DISASSEMBLY AND POST-MORTEM RESULTS. (Los Alamos Scientific Lab., N. Mex.). Sep 1968. Contract W-7405-eng-36. 68p. Dep. NTIS $5.50.
Declassified 29 Aug 1973.

The Phoebus 1B reactor was run for 30 min at full power on February 23, 1967. A maximum power of 1450 MW and a gas temperature of 4400°R at the exit end of the fuel elements were attained early in the test. However, both the power and temperature drifted downward, and time-averages consequently were only 1290 MW and 4150°R. Numerous fuel elements were bonded together by pyrocarbon deposits bridging the external surfaces of the elements between Stations 20 and 25; about 27% of the 1498 elements were broken during removal from the reactor because of this bonding. The average mass loss of the 1100 elements remaining in one piece was 13.7 g. The mid-range area, between Stations 15 and 25, accounted for 44% of the total mass loss. The Mo overcoating applied to the NbC coatings apparently was very effective in reducing mid-range corrosion of those elements with numerous narrow cracks in the NbC, while elements with a few wide cracks in the NbC performed poorly. External corrosion amounted to an average loss of 2 g per fuel element. The periphery of the reactor contained a combination of extremely NbC-coated and uncoated filler elements and fuel elements. The coated elements exhibited far less external surface corrosion and fewer fractures than their uncoated counterparts. The core exit-gas thermocouples gave low readings, and one of these was ejected early during the full-power hold. Thermocouples installed in the center bore of fuel elements were used for the first time; the performance of those at Station 20 was adversely affected by mid-range corrosion during the full-power run. Analyses of two samples of the airborne radioactive material produced by the reactor indicated a release of about 0.5% of the fission-product inventory from the core in the form of fission-product-bearing uranium fuel. Thermal diffusion of fission products accounted for an additional release of about 1%. (auth)

26562 (LA-3849) ROVER GRAPHITE FUEL ELEMENT THERMAL STRESS EXPERIMENTS AND ANALYSES. Lawton, R. G.; Prince, W. R. (Los Alamos Scientific Lab., N. Mex.). Dec 1967. Contract W-7405-eng-36. 50p. Dep. NTIS $4.50.
Declassified 29 Aug 1973.

Current experiments and analyses to establish the power-density and thermal-stress limitations of graphite fuel elements in Rover reactor cores are summarized. Significant experimental improvements, modifications, and advances in analytical techniques have been achieved. Results for fuel elements loaded with pyrocarbon-coated UC_2 fuel beads are reported. Procedures have been devised to avoid excessive corrosion by the hydrogen coolant. A significant correlation, as a function of temperature, between the calculated stress and the experimental data at fracture has been established. Using this derived correlation, based upon thermal-stress limits only, it is concluded that the present (Phoebus 1B and 2A) fuel-element configurations and materials are capable of approximately doubled power density. The experimental techniques and analytical correlations are a significant tool for evaluating the thermal-stress limitations of new fuel-element materials and configurations. (auth)

26563 (LA-3905) QUARTERLY STATUS REPORT OF LASL ROVER PROGRAM FOR PERIOD ENDING FEBRUARY 29, 1968. (Los Alamos Scientific Lab., N. Mex.). Mar 1968. Contract W-7405-eng-36. 63p. Dep. NTIS $5.25.
Declassified 29 Aug 1973.

Research and development activities on the Phoebus 2 and Pewee reactors and associated fuels and materials are described. (JWR)

26564 (LA-3950) HIGH-TEMPERATURE PROTECTIVE HEAT SHIELD. Riley, R. E.; Landahl, C. (Los Alamos Scientific Lab., N. Mex.). 3 Jun 1968. Contract W-7405-eng-36. 29p. Dep. NTIS $3.50.

Declassified 29 Aug 1973.

Development of a high temperature heat shield for a critical load-bearing portion of the hot end of a nuclear rocket engine reactor was investigated. This heat shield would be used in a hydrogen atmosphere to protect the load-support button of the tie rod or tie tube. Tungsten metal alloys having reliable metallurgical and physical characteristics are constantly in demand for advanced nuclear engine applications, and, therefore, were selected for this investigation. The only structural property required of the material was that it be self-supporting at temperatures near 2500°C. A detailed account of the fabrication and testing methods is given, and the high temperature results are discussed. The results of an actual field test in the Phoebus-1B reactor confirmed the results of laboratory work with the tungsten metal alloy materials. Data from the reactor tests are given. (auth)

26565 (LA-4071) QUARTERLY STATUS REPORT OF LASL ROVER PROGRAM FOR PERIOD ENDING NOVEMBER 30, 1968. (Los Alamos Scientific Lab., N. Mex.). 6 Jan 1969. Contract W-7405-eng-36. 77p. Dep. NTIS $6.00.

Declassified 29 Aug 1973.

Information is presented concerning Pewee 1 design parameters and neutronics, Pewee 2 design parameters and neutronics, Phoebus 2A test results, Nuclear Furnace Reactor neutronics and component testing, mechanical properties and fabrication procedures for graphite, mechanical properties and fabrication procedures for UC–ZrC fuel elements, and mechanical properties of pyrolytic carbon coated UC_2 fuel particles. (DCC)

26566 (LA-4105) IMPROVED METHOD OF FUEL ELEMENT INCREMENTAL MASS MEASUREMENTS. Winkler, M. A.; Fullbright, H. J. (Los Alamos Scientific Lab., N. Mex.). 1 Jul 1969. Contract W-7405-eng-36. 9p. Dep. NTIS $3.00.

Declassified 28 Aug 1973.

Improvements of the mass per unit length examination (MULE) system have led to development of the MULE-3 design. This design improves the statistical accuracy of the measurement and reduces the variation of mass-change sensitivity over the cross-sectional plane of the Rover fuel element under test. As in the original system, a measurement of the gamma transmission from a ^{60}Co source provides an indication of the incremental mass of a fuel element. This measurement produces a mass-gain profile for element coatings as well as a mass-loss profile for corrosion-tested elements. Data on the construction, calibration, and performance of the MULE-3 systems are presented. (auth)

26567 (LA-4134) LASL ROVER PROGRAM. Quarterly Status Report for Period Ending February 28, 1969. (Los Alamos Scientific Lab., N. Mex.). 25 Mar 1969. Contract W-7405-eng-36. 71p. Dep. NTIS $5.75.

Declassified 28 Aug 1973.

Information is presented concerning Pewee 1 test results, Pewee 2 design parameters and component fabrication, mechanical properties of graphite, mechanical properties and fabrication of Uc–ZrC fuel elements, and performance testing of pyrolytic carbon coated UC_2 fuel particles. (DCC)

26568 (LA-4159) PHOEBUS 2A PRELIMINARY REPORT. (Los Alamos Scientific Lab., N. Mex.). Jan 1969. Contract W-7405-eng-36. 121p. Dep. NTIS $8.25.

Declassified 28 Aug 1973.

Phoebus 2A was tested successfully between May 22 and August 18, 1968 at the Nuclear Rocket Development Station, Jackass Flats, Nevada. Four experimental plans (EPs) were originally proposed, but five were finally conducted to identify some inconsistencies discovered in earlier tests. Highest operating conditions were attained during EP-IV; the reactor was held for 12-½ min at ~80% of design power, flow rate, and fuel-element exit-gas temperature before the experiment was concluded with a normal shutdown. A maximum power of ~4100 MW and a fuel-element exit-gas temperature of 4150°R were attained at a LH_2 flow rate of 260 lb/sec. Maximum operating conditions could not be reached because the aluminum segments of the pressure-vessel clamp band overheated prematurely. (auth)

26569 (LA-4217) PEWEE 1 REACTOR TEST REPORT. (Los Alamos Scientific Lab., N. Mex.). Jun 1969. Contract W-7405-eng-36. 118p. Dep. NTIS $8.00.

Declassified 28 Aug 1973.

Pewee 1 was a small reactor designed to serve as a test bed for nuclear rocket fuel elements and other core components. The general design was directed toward providing a realistic nuclear, thermal, and structural environment for fuel elements in a core containing one-fourth the number of elements in Phoebus 1 and NRX reactors. The reactor was tested in three Experimental Plans at Test Cell C at NRDS. The full-power test consisted of two 20-min holds at ~500 MW and a fuel-element exit-gas temperature of ~4600°R. The fuel-element power density and exit-gas temperature were the highest yet attained in the Rover program. The primary objective of demonstrating the capability of the reactor as a fuel-element test bed was achieved, and valuable fuel-element endurance evaluation was obtained. (auth)

26570 (LA-4270) QUARTERLY STATUS REPORT OF LASL ROVER PROGRAM FOR PERIOD ENDING AUGUST 31, 1969. Skoberne, F. (comp.) (Los Alamos Scientific Lab., N. Mex.). 29 Sep 1969. Contract W-7405-eng-36. 69p. Dep. NTIS $5.50.

Declassified 28 Aug 1973.

Information is presented concerning Pewee 1 performance testing, Pewee 2 design parameters and fabrication, Nuclear Furnace Reactor design parameters and neutronics, mechanical properties of graphite, and fabrication and mechanical properties of UC–ZrC fuel elements. (DCC)

26571 (LA-4418) QUARTERLY STATUS REPORT OF LASL ROVER PROGRAM FOR PERIOD ENDING FEBRUARY 28, 1970. (Los Alamos Scientific Lab., N. Mex.). 31 Mar 1970. Contract W-7405-eng-36. 63p. Dep. NTIS $5.25.

Declassified 28 Aug 1973.

Information is presented concerning Pewee 2 design parameters and fabrication, Pewee 3 design parameters and neutronics, Nuclear Furnace Reactor neutronics, mechanical properties of graphite, mechanical properties and performance testing of UC–ZrC fuel elements, and fabrication and performance testing of pyrolytic carbon coated UC_2 fuel particles. (DCC)

26572 (LA-4455) NEUTRONICS OF THE PHOEBUS-2 REACTOR. Sapir, J. L.; Orndoff, J. D. (Los Alamos Scientific Lab., N. Mex.). Mar 1970. Contract W-7405-eng-36. 57p. Dep. NTIS $5.00.

Declassified 28 Aug 1973.

Neutronic studies of the Pheobus-2 rocket propulsion reactor, a prototype for a 5000-MW, 250,000-lb thrust engine, are reported. The neutronic characteristics were established through measurements on a series of critical assembly mockups coupled with a parallel computational program. The full-scale test of this reactor resulted in larger cold-to-hot changes in reactivity than had been predicted. Extensive posttest analysis was able to resolve the discrepancies. (auth)

26573 (LA-4468) QUARTERLY STATUS REPORT OF LASL ROVER PROGRAM FOR PERIOD ENDING MAY 31, 1970. (Los Alamos Scientific Lab., N. Mex.). Jun 1970. Contract W-7405-eng-36. 74p. Dep. NTIS $5.75.

Declassified 28 Aug 1973.

Information is presented concerning Pewee 2 design parameters and neutronics, Pewee 3 design parameters, Nuclear Furnace Reactor design parameters and neutronics, mechanical properties of graphite, development and performance testing of UC–ZrC fuel elements, mechanical properties of ZrC, and mechanical properties of pyrolytic carbon coated UC_2 particles. (DCC)

26574 (LA-4522) QUARTERLY STATUS REPORT OF LASL ROVER PROGRAM FOR PERIOD ENDING AUGUST 31, 1970. (Los Alamos Scientific Lab., N. Mex.). Sep 1970. Contract W-7405-eng-36. 79p. Dep. NTIS $6.00.

Declassified 29 Aug 1973.

Information is presented concerning Pewee 2 design parameters and neutronics, Pewee 3 design parameters and neutronics, Nuclear Furnace Reactor neutronics and component fabrication, mechanical properties of graphite, mechanical properties and performance testing of UC–ZrC fuel elements, and mechanical properties of ZrC. (DCC)

26575 (LA-4579) QUARTERLY STATUS REPORT OF LASL ROVER PROGRAM FOR PERIOD ENDING NOVEMBER 30, 1970. (Los Alamos Scientific Lab., N. Mex.). Dec 1970. Contract W-7405-eng-36. 66p. Dep. NTIS $5.50.

Declassified 29 Aug 1973.

Information is presented concerning Pewee 2 design parameters and neutronics, Pewee 3 design parameters, mechanical properties and fabrication procedures for graphite, fabrication and performance testing of UC–ZrC fuel elements, and mechanical properties of ZrC coatings. (DCC)

26576 (LA-4654) QUARTERLY STATUS REPORT OF LASL ROVER PROGRAM FOR PERIOD ENDING FEBRUARY 28, 1971. (Los Alamos Scientific Lab., N. Mex.). Mar 1971. Contract W-7405-eng-36. 52p. Dep. NTIS $4.75.

Declassified 29 Aug 1973.

Information is presented concerning Pewee 2 test results, Nuclear Furnace Reactor design parameters and neutronics, performance testing of UC–ZrC fuel elements, and mechanical properties of ZrC coatings. (DCC)

26577 (LA-4683) FABRICATION OF PHOEBUS-2 TIE TUBE ASSEMBLIES. Part I. Development. Kirby, R. S.; Hanks, G. S. (Los Alamos Scientific Lab., N. Mex.). Jul 1971. Contract W-7405-eng-36. 41p. Dep. NTIS $4.25.

Declassified 29 Aug 1973.

Approximately 1500 tie-tube assemblies were fabricated for use in the Phoebus-Cold Flow and Phoebus-2A reactors. The assemblies, made from Inconel 718 and Inconel 600 alloy components, contained 14 separate joints, 12 of which were brazed and two welded. Approximately half of the metal components were fabricated by CMB-6; who did all of the assembly work as well as the heat treatment of the assemblies and subassemblies. The design of the tie-tube assemblies required that each structural brazed joint have greater than 70% coverage. The coverage in the majority of the joints, as determined by radiographic techniques, was greater than 90%. The specifications also required that the brazing and heat treating cycles be designed to produce final assemblies with a tensile strength >180 kpsi and a yield strength >155 kpsi. The typical final assembly had a tensile strength >200 kpsi and a yield strength >160 kpsi. The alloy chosen for all structural brazes was 82 Au–18 Ni with a flow point of 1800°F. The assembly design was such that the structural brazes were made in one brazing step. Two other alloys, Au–8 Pd–22 Ni (flow point 1920°F) and Au–16.5 Cu–2 Ni (flow point 1720°F) were used for preceding and subsequent brazes. All surfaces to be brazed were plated with ~0.0005 in. nickel to insure good filler-metal flow. Brazing and heat treating was done in an argon atmosphere with <1 ppm H_2O and <2 ppm O_2. The gas was gettered to this low impurity level using a molecular-sieve drier in series with a copper-wool gettering furnace. The assemblies were fixtured and run, 120 assemblies per load, in a cam-controlled resistance furnace capable of 2000°C intermittent operation. 5 references. (auth)

26578 (LA-4779) QUARTERLY STATUS REPORT OF LASL ROVER PROGRAM FOR PERIOD ENDING AUGUST 31, 1971. (Los Alamos Scientific Lab., N. Mex.). Sep 1971. Contract W-7405-eng-36. 51p. Dep. NTIS $4.75.

Declassified 29 Aug 1973.

Information is presented concerning the Nuclear Furnace Reactor design parameters and neutronics, fabrication and mechanical properties of UC–ZrC fuel elements, and mechanical properties of ZrC. (DCC)

26579 (LA-4922) QUARTERLY STATUS REPORT OF LASL ROVER PROGRAM FOR THE PERIOD ENDING FEBRUARY 29, 1972. (Los Alamos Scientific Lab., N. Mex.). Mar 1972. Contract W-7405-eng-36. 50p. Dep. NTIS $4.50.

Declassified 29 Aug 1973.

Information is presented concerning Nuclear Furnace Reactor design parameters and fabrication, design parameters for a small nuclear rocket engine, mechanical properties and performance testing of UC–ZrC fuel elements, and mechanical properties of ZrC. (DCC)

26580 (LA-4997) QUARTERLY STATUS REPORT OF LASL ROVER PROGRAM FOR THE PERIOD ENDING MAY 31, 1972. (Los Alamos Scientific Lab., N. Mex.). Jun 1972. Contract W-7405-eng-36. 60p. Dep. NTIS $5.00.

Information is presented concerning design parameters and neutronics for a small nuclear rocket engine, Nuclear Furnace Reactor operations, Pewee 3 neutronics, fabrication and performance testing of UC–ZrC fuel elements, and mechanical properties of ZrC. (DCC)

26581 (LA-5005) DEVELOPMENT OF CARBIDE–CARBON COMPOSITE FUEL ELEMENTS FOR ROVER REACTORS. Davidson, K. V.; Martin, W. W.; Schell, D. H.; Taub, J. M.; Taylor, J. W. (Los Alamos Scientific Lab., N. Mex.). Oct 1972. Contract W-7405-eng-36. 24p. Dep. NTIS $3.25.

Nineteen-hole hexagonal fuel elements containing 30 vol% (U,Zr)C in graphite were produced for the Rover reactor program. The elements were extruded from a mix consisting of graphite flour, carbon black, ZrC, UO_2, and liquid thermosetting binder. Solid-solution (U,Zr)C was formed in the elements during heat treatment. Parameters were developed for the extrusion and heat-treating operations. Specifications for raw materials evolved during the course of this program. An investigation of extrusion-die materials was undertaken, and Ferro-TiC was selected as the best material available. Techniques for brazing composite fuel elements to hot-pressed tips of refractory-metal carbide-graphite composite material and to other elements were developed. (auth)

26582 (LA-5054) QUARTERLY PROGRESS REPORT OF LASL ROVER PROGRAM FOR THE PERIOD ENDING AUGUST 31, 1972. Skoberne, F. (comp.) (Los Alamos Scientific Lab., N. Mex.). Sep 1972. Contract W-7405-eng-36. 53p. Dep. NTIS $4.75.

Declassified 29 Aug 1973.

Progress made in the Rover Program at the Los Alamos Scientific Laboratory is reported for the quarter ending August 31, 1972. Major efforts were the publication of a Preliminary Report for the Nuclear Engine Definition Study; Nuclear Furnace design and development, including the successful testing of Nuclear Furnace-1; further development of carbide-graphite composite materials; and carbide fuel and carbide component research. Other areas reported include NRDS activities, nondestructive testing, properties-of-materials research, and irradiation tests. (auth)

26583 (LAMS-2630) KIWI-A PRIME TEST SERIES. Part II. Final Report on the Kiwi-A3 Full Power Run. Brown, D. W. (Los Alamos Scientific Lab., N. Mex.). 1 Sep 1961. Contract W-7405-eng-36. 67p. Dep. NTIS $5.50.

Declassified 29 Aug 1973.

The second reactor in the Kiwi-A Prime Test Series—Kiwi A3—was tested at full power on October 19, 1960 at the Nevada Test Site. As originally planned, the reactor was to have been operated for 250 seconds at a power level of 92 megawatts while maintaining a core exit gas temperature of 3912°R through adjustments in the coolant (hydrogen) mass flow rate. However, due to calibration errors in the neutronic power measuring system, the reactor was actually operated at an average power level of 112.5 megawatts for 259 seconds. Even though the reactor was operated 22 percent above the designed power level, there was sufficient reserve coolant flow capability to hold the average exit gas temperature at the specified level during the full-power plateau. The performance of the Kiwi A3 core and fuel elements during the full-power run was considerably improved over that of the Kiwi-A Prime reactor. The longer Kiwi A3 fuel elements, utilizing carbided niobium liners rather than the vapor-deposited niobium coatings employed previously, exhibited none of the coolant passage surface blistering and graphite corrosion so prevalent in some of the Kiwi-A Prime fuel elements. The module failures which occurred during the Kiwi-A Prime full-power run also occurred during the Kiwi A3 experiment, but to a considerably lesser degree. One module failed by transverse fracture during the full-power run while two others failed for the same reason during handling in disassembly. (auth)

26584 (LAMS-2646) GAS DEPOSITION OF PYROLYTIC GRAPHITE AND NIOBIUM CARBIDE PROTECTIVE COATINGS ON GRAPHITE FUEL ELEMENTS OF KIWI-A PRIME AND KIWI-A3. Windburn, D. C.; Money, R. K.; Krohn, R.; Gutierrez, C. P.; Moulton, G. H.; Bowman, M. G.; Vier, D. T. (Los Alamos Scientific Lab., N. Mex.). 5 Sep 1961. Contract W-7405-eng-36. 42p. Dep. NTIS $4.25.

Declassified 29 Aug 1973.

The methods and apparatus used to coat Kiwi-A Prime and Kiwi-A3 graphite fuel elements with a protective coating of NbC are described. A new coating method was employed for this purpose. It consisted of the high-temperature reaction of a gaseous mixture of niobium pentachloride, hydrogen, and hydrogen chloride with the graphite of the fuel element to form a NbC coating on the element. Since this gas mixture also reacts with the uranium dicarbide in the fuel element to form volatile uranium tetrachloride gas, an initial impervious pyrolytic graphite coating was deposited on the elements. Both of these coating processes are described in detail, as well as the procedures for inspection and evaluation of the coats. (auth)

26585 (LAMS-2668) NbC CLADDING OF BORES AND NbC VAPOR COATING OF ENDS OF URANIUM-LOADED GRAPHITE FUEL ELEMENTS FOR KIWI-B1A. Windburn, D. C.; Money, R. K.; Krohn, R.; Drumhiller, W. L.; Bowman, M. G. (Los Alamos Scientific Lab., N. Mex.). 9 Jan 1962. Contract W-7405-eng-36. 61p. Dep. NTIS $5.25.

Declassified 29 Aug 1973.

The apparatus and procedures used in the processing of uranium-loaded graphite fuel elements of Kiwi-B1A reactor to provide a protective NbC covering on the bore and end surfaces are described. The bore surfaces were lined with a 0.0025-in.-thick cladding of NbC by inserting seamless Nb tubing into the bores

and heat treating the element and tubing to form an adherent NbC lining. End faces of the elements were coated with ~0.002 in. of NbC by a nondiffusion-controlled vapor coating method that deposited NbC from a gaseous mixture of He, H_2, CH_4, and $NbCl_5$ at 1800 to 1900°C on the uranium-loaded graphite surface. Exit end supports of graphite for each hole in the reactor modules were coated with 0.003 to 0.004 in. of NbC by a duffusion-controlled method of vapor coating that forms NbC on graphite surfaces at approximately 2000°C from a gaseous mixture of He, H_2, HCl, and $NbCl_5$. Evaluation of the NbC protective coatings by radiography and simulated reactor environmental testing with H_2 is also presented. A description of a pyrolytic graphite coating technique that provides a thin (0.001 in.) coating of graphite on exterior surfaces of a sampling of fuel elements to aid in post mortem radiochemical analysis is included. (auth)

26586 (LAMS-2708) FINAL REPORT ON THE KIWI-B-1A FULL POWER RUN. Brown, D. W.; Cerni, S. (Los Alamos Scientific Lab., N. Mex.). 20 Apr 1962. Contract W-7405-eng-36. 99p. Dep. NTIS $7.00.

Declassified 29 Aug 1973.

Kiwi-B-1A, the first in the Kiwi-B series of reactors to be designed and tested by the Los Alamos Scientific Laboratory as part of the Rover program, was operated at full power on December 7, 1961 at the Nevada Test Site. As originally planned, the reactor was to have been operated for 300 seconds at a nominal power level of 270 megawatts with a hydrogen flow rate of 20 lbs/second, the power level being automatically adjusted to maintain a core exit gas temperature of 4100°R. However, as a result of the intentional opening of the temperature control loop and a considerable calibration error in the linear neutronics system, the reactor only reached a power level of 225 megawatts. Unfortunately, it was necessary to terminate the experiment soon after reaching the full-power plateau due to several large and potentially dangerous hydrogen fires near the nozzle flange area, the actual full-power duration being only approximately 36 seconds. Notwithstanding the brief duration of the full-power plateau at lower-than-design conditions, considerably more information was obtained from the Kiwi-B-1A test than from any previous Kiwi full-power test. Post-run analysis of the reduced thermocouple data indicates that the core radial temperature distributions were essentially uniform as planned, while the azimuthal temperature distribution at the core O.D. shows two depressed temperature areas as the result of bypass coolant flow between the core and the core sleeve assembly. The large radial temperature gradients across the peripheral modules located in the regions of by-pass flow appear to have resulted in the observed large transverse cracks on each of four modules. A different and as yet unexplained temperature irregularity existed near the edge of the core as measured by thermocouples 8 inches from the inlet end of the core. Large azimuthal temperature gradients ranging up to 400°R were observed across several outer modules at this axial location. The measured core axial temperature profiles at the intermediate and full-power portions of the run show excellent agreement with the analytically-predicted profiles. (auth)

26587 (TNR-230(Vol.1)) TECHNICAL SUMMARY REPORT OF NERVA PROGRAM. Phase I: NRX and XE. Volume I. Engineering Design and Analysis Techniques and Development. (Westinghouse Electric Corp., Pittsburgh, Pa. Astronuclear Lab.). 15 Jul 1972. Contract SNSO-1. 423p. Dep. NTIS $23.25.

Information on the nuclear and radiation design and analysis, thermal/fluid analysis, structural design and analysis techniques, and systems design and analysis for the NRX and XE reactors in the NERVA program is summarized. (JWR)

26588 (TNR-230(Vol.2)) TECHNICAL SUMMARY REPORT OF NERVA PROGRAM. Phase I: NRX and XE. Volume II. NERVA Component Development and Testing. (Westinghouse Electric Corp., Pittsburgh, Pa. Astronuclear Lab.). 15 Jul 1972. Contract SNSO-1. 389p. Dep. NTIS $21.50.

The development, test program, and test results for components and materials for NRX and XE reactors are summarized. (JWR)

26589 (TNR-230(Vol.3)) TECHNICAL SUMMARY REPORT OF NERVA PROGRAM, PHASE I NRX AND XE. Volume III. Full Scale Test Program. (Westinghouse Electric Corp., Large, Pa. Astronuclear Lab). 15 Jul 1972. Contract SNSO-1. 95p. Dep. NTIS.

A concise, comprehensive narrative of the technical history of the full scale test program, including the identification, analysis and solution of technical problems which contributed to the technological development of the NERVA engine is presented. Emphasis is placed on the motivating reasons for the test program. Reactor tests NRX-A1 to NRX-A6 and also NRX/EST, XECF, and XE-Prime are included. Also included are the significant findings of the KIWI program which had an impact upon the NERVA program. (auth)

26590 (TNR-230(Vol.3)(Add.)) TECHNICAL SUMMARY REPORT OF NERVA PROGRAM, PHASE I NRX AND XE. Addendum to Volume III. Full Scale Test Program: Review of Reactor/Engine Firing Positions. (Westinghouse Electric Corp., Large, Pa. Astronuclear Lab.). 31 Jul 1972. Contract SNSO-1. 22p. Dep. NTIS.

Work done on the horizontal, up, and down firing of NERVA engines is reviewed. (JWR)

26591 (TNR-230(Vol.4)) TECHNICAL SUMMARY REPORT OF NERVA PROGRAM, PHASE I NRX AND XE. Volume IV. Technology Utilization Survey. (Westinghouse Electric Corp., Large, Pa. Astronuclear Lab.). 31 Jul 1972. Contract SNSO-1. 186p. Dep. NTIS.

Technology spinoffs from the NERVA Program which could be of potential use to business and industry are discussed. An attempt is made to identify that technology which might be applicable to other advanced technical programs. The spinoff items were identified by screening the NERVA technical documentation. (JWR)

26592 (TNR-230(Vol.5)) TECHNICAL SUMMARY REPORT OF NERVA PROGRAM. Volume V. Abstracts of Significant NERVA Documentation. (Westinghouse Electric Corp., Large, Pa. Astronuclear Lab.). Sep 1972. Contract SNSO-1. 178p. Dep. NTIS.

Summaries of significant NERVA documentation are presented in technical abstract form for external use. The intent is to provide both document identification and quantitative technical summaries so that, for many users, these abstracts themselves may provide sufficient information for their uses. The format of the abstracts was established so as to be suitable for technology utilization dissemination and to be readily adaptable for dissemination in other ways. (JWR)

26593 (TNR-230(Vol.6)) TECHNICAL SUMMARY REPORT OF NERVA PROGRAM. Volume VI. Technology Dissemination from the Nuclear Rocket Program: New Companies, Capabilities, Processes, and Products. (Westinghouse Electric Corp., Pittsburgh, Pa. Astronuclear Lab.). Dec 1972. Contract SNSO-1. 35p. Dep. NTIS $3.75.

A limited effort was initiated to trace some of the technology transfer and upgrading of industrial capability resulting from the impetus of the nuclear rocket program. The specific intent was to identify industrial products, processes, capabilities and new contractor organizations resulting from the stimulus of the NERVA (Nuclear Engine Rocket Vehicle Application) Program. The preliminary findings of the limited investigation are discussed. The avenues of search are described and results are listed under several categories. The preliminary search effort was devoted to seeking those component vendors associated with new products, new manufacturing techniques and quality control changes, to finding development and testing laboratories with increased capability, to finding who in the NERVA project team knew about the changes, and to obtaining a brief description of what transpired at the time. There are a number of additional avenues still remaining to search and leads to follow as well as the necessity for continuing with direct interviews and getting confirmation from the organization concerned. (JWR)

Reactor Safety and Environmental Aspects

Refer also to abstracts 24363, 24443, 24503, 26475, 26674, and 26944.

26594 (AEC-tr-7456) PROBABILITY OF MALFUNCTION IN THE CONTAINMENT BUILDING SPRINKLER SYSTEM AT THE FESSENHEIM POWER PLANT. Signoret, J. P. 1973. Translation of SETS report No. 17. 12p. Dep. NTIS $3.00.

A reliability study of the containment sprinkler system at the Fessenheim power plant reveals that the components installed on the direct sprinkler lines are most likely to cause a system failure. The testing and recirculation lines have practically no influence on the probability of sprinkler failure. (JWR)

26595 (BAW-10053) MULTINODE ANALYSIS OF B AND W's 177-FUEL-ASSEMBLY, NON-VENT-VALVE PLANT DURING LOCA. Parks, C. E.; Cartin, L. R.; Shieh, K. C. (Babcock and

Wilcox Co., Lynchburg, Va. (USA). Nuclear Power Generation Div.). Jun 1973. 115p. Dep. NTIS $7.75.

The multinode evaluation of several loss-of-coolant accidents for B&W's 2772-MW(t) non-vent-valve, nozzle supported nuclear power plants with prepressurized fuel pins is described. The basic computer code is discussed, including modifications that have been incorporated to make it more applicable to the system analyzed. Also, basic assumptions and areas of uncertainty and conservatism are discussed. The multinode model was used to perform a core cooling analysis for a spectrum of break sizes in the cold and hot legs of the reactor coolant system. Curves showing hot spot fuel cladding temperature versus time after an assumed break are included for a spectrum of hot and cold leg break sizes. (auth)

26596 (BAW-10055(Rev.1)) FUEL DENSIFICATION REPORT. Turner, R. A. (Babcock and Wilcox Co., Lynchburg, Va. (USA). Nuclear Power Generation Div.). Jun 1973. 106p. Dep. NTIS $7.50.

The Regulatory Staff of the U. S. Atomic Energy Commission has concluded that adequate data are available to account for the effects of fuel densification in the safety evaluations of nuclear power reactors. Considerable reliance was placed on direct application of data obtained from operating reactors. These reactors have been operated safely with densified fuel and collapsed cladding, and the Regulatory Staff has concluded that implementation of the recommendations of their report, "Technical Report on Densification of Light Water Reactor Fuels," will provide increased assurance of safe operation of reactors in which fuel densification is expected to occur. The AEC recommendations and guidelines have been implemented and reported herein. This report has been revised to incorporate the revised power spike model based on results obtained from Brookhaven National Laboratory. In addition, several minor corrections have been made for clarity and accuracy. Appendix A contains the answers to AEC questions which resulted from the review of B&W fuel and are included in this report for clarity and completeness. (auth)

26597 (BNWL-B-291) DISCUSSION OF NEED FOR HOT WALLS IN CORE BYPASS ECC EXPERIMENTS. Allemann, R. T. (Battelle Pacific Northwest Labs., Richland, Wash.). Jul 1973. Contract AT(45-1)-1830. 53p. Dep. NTIS $4.00.

An experiment is being planned to study the delivery of Emergency Core Cooling (ECC) water to the lower plenum of a pressurized water reactor during the course of a cold leg break loss-of-coolant accident. The experiment is being designed to simulate in as large a physical scale as possible, the countercurrent flow of the injected coolant and the reverse core steam flow in the annulus. It has been suggested that perhaps the walls of such an experiment should be heated to simulate the hot walls of a reactor system at the time of blowdown and ECC injection. Such heating is not planned for most of the experiments and the basis for this is explained. (auth)

26598 (CENPD-80(Rev.1)) MOISTURE CARRYOVER DURING AN NSSS STEAM LINE BREAK ACCIDENT. Kling, C. L.; Peeler, G. B. (Combustion Engineering, Inc., Windsor, Conn. Nuclear Power Dept.). Jun 1973. 32p.

Experimental and analytical results have been employed to determine the moisture carryover fraction expected as a function of discharge area and initial conditions for the blowdown of a Combustion Engineering U-tube steam generator during a steam line break accident. The experimental data were analytically checked for thermodynamic consistency and precision. An analytical model was developed to correlate the experimental data. The model predicts the measured moisture carryover fractions, in every case predicting less moisture carryover than that measured during the transient. The same analytical model is applied to U-tube steam generator geometry. Using Combustion Engineering's NSSS simulation code, CESEC, analyses of the effects of moisture carryover on the NSSS during the steam line break accident were compared with the Calvert Cliffs FSAR results without moisture carryover. For results using the expected moisture carryover fraction (77 percent), the core power transient is eliminated and, for the case of a break inside containment, the total energy added to the containment is greatly reduced. (auth)

26599 (CTC-37(Rev.1)) CONSOLE-ORIENTED INFORMATION STORAGE AND RETRIEVAL SYSTEM FOR THE NUCLEAR SAFETY INFORMATION CENTER. Hairston, E. L.; Stoutt, B. H.; Yount, S. L. (Union Carbide Corp., Oak Ridge, Tenn. Computing Technology Center). 31 Aug 1973. Contract W-7405-eng-26. 129p. Dep. NTIS $5.45.

The basic functions and operating procedures of the information storage and retrieval system developed for the Nuclear Safety Information Center (NSIC) are described. This system was designed and implemented by the staff of the Computing Technology Center for the IBM 360/50-65. Bibliographic information is input primarily via IBM 2260 Display Stations with an alternate means provided through punched cards processed in the background batch environment. The Master and Index files are stored on direct access devices with backup maintained on magnetic tapes. The direct access files may be searched in a nonsequential manner using teleprocessing programs designed for use with the IBM 1050, 2740, and 2260 slow- and intermediate-speed terminals. In addition, retrospective searching and selective dissemination of information (SDI) capabilities are provided in the batch mode using the magnetic tape backup files as input. 3 references. (auth)

26600 (GEAP-13923-3) SODIUM-COOLED REACTORS SAFETY ENGINEERING PROGRAM. Third Quarterly Report, February–April 1973. (General Electric Co., Sunnyvale, Calif. Breeder Reactor Dept.). May 1973. Contract AT(04-3)-893. 40p. Dep. NTIS $4.00.

The Demonstration Plant will demonstrate the safe, economical generation of electric power from a liquid-metal cooled fast breeder reactor. Many aspects of the safety of such a plant have been under study for several years. The existing LMFBR activity concerning safety includes both analytical and experimental programs. A major requirement is the establishment of mechanisms for the guidance of the National Safety Program in the integration of these analytical and experimental programs. The guidance must establish specific objectives, priorities, and schedules for the programs, and it must provide a mechanism for identifying and correcting whatever problems arise before they interfere with the schedule for the design and construction of the Demonstration Plant. The purpose of this project is: (1) to bring into sharp focus both the requirements or needs for specific technical information related to safety, and the results of previous studies, wherever performed; (2) to recommend to AEC-RDT a course of action which will provide the information still required. 10 references. (auth)

26601 (GEAP-13936) FREADM CODE DEVELOPMENT: A STATUS REPORT. Freeman, D. D. (comp.) (General Electric Co., Sunnyvale, Calif. Breeder Reactor Dept.). May 1973. Contract AT(04-3)-893. 150p. Dep. NTIS $5.45.

Development of fast reactor accident analysis methods was funded under Task G-10 of PA-10 during FY-72. A portion of this effort was directed toward updating the FREADM accident analysis code to improve models for fuel rod failure and coolant dynamics under transient overpower and loss-of-flow accident situations. This effort was directed toward adequately coupling models for fuel and coolant dynamics to associated reactivity feedback models, primarily for the purpose of analyzing initiating phases of hypothetical fast reactor accidents. USAEC support of this effort was terminated at the end of FY-72. The status of the code developed as of that time is summarized. A user's manual for the code is included. 11 references. (auth)

26602 (IRS-F-15) REPORTS ON RESEARCH PLANS IN THE FIELD OF REACTOR SAFETY PROMOTED BY THE MINISTRY FOR RESEARCH AND TECHNOLOGY. Period Covered: January 1–March 31, 1973. (Technischer Ueberwachungs-Verein E. V., Cologne (West Germany). Institut fuer Reaktorsicherheit). Jul 1973. 198p. (In German). Dep. NTIS (U. S. Sales Only) $12.00.

Reactor-safety related research activities during January through March 1973 are reported. (JWR)

26603 (IRS-T-20) INFORMATION VISIT TO BRITISH RESEARCH ESTABLISHMENT WORKING IN THE FIELD OF FAST REACTOR SAFETY EVALUATION. (Technischer Ueberwachungs-Verein E. V., Cologne (West Germany). Institut fuer Reaktorsicherheit). May 1973. 49p. (In German). Dep. NTIS (U. S. Sales Only) $4.50.

The respective German licensing authorities initiated a trip to English research establishments to get valuable information for the safety evaluation and licensing of the planned sodium cooled fast reactor (Schneller Natriumgekuehlter Reaktor, SNR-300). This information trip was conducted from June 10–16, 1971. Leading English research establishments operated by the United Kingdom Atomic Energy Authority (UKAEA) which are engaged in safety research on fast reactors were visited in order to learn as much as possible from English experiments and results of the corresponding safety research. The trip was prepared by the Ministry of Labour, Health and Social Affairs of Northrhine-Westfalia (Minister fuer Arbeit, Gesundheit und Soziales des Landes Nordrhein-Westfalen) with the support of the UKAEA. The nine representatives of the German licensing authorities and the assessing staff visited the Dounreay Experimental Reac-

tor Establishment, the Safety and Reliability Directorate, Risley, and the Atomic Weapon Research Establishment, Foulness. Details of the visits and results of the discussion with the English experts are given. (GE)

26604 (LAMS-2542) ACCIDENT AND TRANSIENT CHARACTERISTICS OF KIWI-B REACTORS. Brown, E. A.; Charmatz, A. W.; Erickson, P. B. (Los Alamos Scientific Lab., N. Mex.). 6 Apr 1961. Contract W-7405-eng-36. 50p. Dep. NTIS $4.50. Declassified 29 Aug 1973.

Accident and transient studies applicable to Kiwi-B reactors are described. The work was done primarily to determine an optimum control rod system from the standpoints of good system performance and good safety characteristics. Two control rod systems were considered. One was the usual combination of slow shim rods to establish the quiescent operating level, and a small number of fast regulating rods to obtain good system performance for small perturbations. In the second system all rods were identical. Various combinations of maximum rod velocities were considered for both systems. (auth)

26605 (MRR-122) COMPARISON OF CALCULATIONS USING BLAST 2 COMPUTER MODEL TO EXPERIMENTS AND OTHER COMPUTER MODELS FOR ONE-DIMENSIONAL FLOW. Grillenberger, T. (Technische Universitaet Muenchen, Garching (West Germany). Laboratorium fuer Reaktorregelung und Anlagensicherung). Apr 1973. 55p. (In German). Dep. NTIS (U. S. Sales Only) $4.75.

The computer model BLAST-2 calculates one-dimensional two-phase flow of water during large pressure disturbances and has been tested by comparing computational results with several experiments dealing with pressure transients and critical mass flow. In addition the model was compared with other computer models for one-dimensional flow. For this purpose, the theoretical derivation, the method of computation, and above all the applicability of the models were taken into consideration. (GE)

26606 (NP-19733) NVE GIVES INFORMATION ON NUCLEAR POWER PLANTS. (Norges Vassdrags- OG Elektrisitetsvesen, Oslo). 1973. 39p. (In Norwegian). Dep. NTIS (U. S. Sales Only) $4.00.

It is probable that the decision on the first Norwegian nuclear power plant, a BWR or PWR, will be made in the near future. Norges Vassdrags- og Elektrisitetsvesen (NVE), the state utility, has published this first brochure of a series to inform the public of the nature of nuclear power, its social, economic and environmental significance and NVE's plans for its development. A survey of the structure of the power supply system with a prognosis to 1990 is given, relating hydroelectric resources to thermal power plans and comparing oil fired, gas and nuclear plants. Brief descriptions of BWR and PWR systems are given and safety and radiation hazards briefly discussed. Siting is discussed from technical and economic aspects, and thermal pollution, environmental factors, social consequences and release of radioactive materials are also evaluated. The brochure is richly illustrated in color. (NO)

26607 (NP-19747) LOCATION OF NUCLEAR POWER PLANT IN THE OSLOFJORD DISTRICT. (Norges Vassdrags- og Elektrisitetsvesen, Oslo). 1973. 67p. (In Norwegian). Dep. NTIS (U. S. Sales Only) $5.50.

A survey of the sites reviewed for the first Norwegian nuclear power plant, to be built in the Oslofjord district, is presented. The time plan, leading to commercial operation in 1982 is given, together with the organization plan for investigation, evaluation and information. Following a general discussion of the district's topography and population distribution, the projected electricity grid is shown and the economic and technical considerations in the site selection are summarized. The comparative evaluations for the recipient and safety and sociology are given for all 20 sites. Thereafter a detailed presentation and discussion of each of the 20 sites are given. Colored maps of the sites are presented in scale 1:50000. (NO)

26608 (NP-19830) ACTIVITIES REPORT, 1972. (Technischer Ueberwachungs-Verein E. V., Cologne (West Germany). Institut fuer Reaktorsicherheit). [nd]. 141p. (In German). Dep. NTIS (U. S. Sales Only) $9.25.

Reactor-safety related research activities during 1972 are summarized. (JWR)

26609 (ORNL-TM-4261) LMFBR SAFETY AND CORE SYSTEMS PROGRAMS PROGRESS REPORT FOR MARCH–APRIL 1973. Fontana, M. H. (Oak Ridge National Lab., Tenn.). Aug 1973. Contract W-7405-eng-26. 73p. AT.

Experiments performed in the FFM facility are described. Temperature distributions and flow characteristics in fuel bundles with partial blockage are measured. The development of electric heaters for the FFM facility is described. (DCC)

26610 (ORNL-tr-2715) REST: PROGRAM FOR CALCULATING THE FISSION PRODUCT ACTIVITY AND DECAY RATE AFTER VARIABLE REACTOR HISTORY IN TWO COUPLED SYSTEMS, TAKING INTO ACCOUNT FISSION PRODUCT ESCAPE. Waibel, E. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Reaktorentwicklung). Apr 1973. Translated from KFK-1579. 40p. Dep. NTIS $4.00.

The FORTRAN programs REST 1, REST 2, and REST 3 were developed for the calculation of the fission product decay heat source within a nuclear reactor. REST 3 considers a distribution of the heat source by calculating fission product escape out of the fuel, as might be expected by accidental overheating of the core. The time dependency of the heat source within and outside the fuel is shown. A description and a user's guide for the programs is given. A BWR was used as a model for the calculations. (12 references) (auth)

26611 (WCAP-8172) PIPE BREAKS FOR THE LOCA ANALYSIS OF THE WESTINGHOUSE PRIMARY COOLANT LOOP. (Westinghouse Electric Corp., Pittsburgh, Pa.). Jul 1973. 116p. Dep. NTIS $8.00.

The criteria for postulated pipe ruptures for the analysis of loss-of-coolant accidents in the primary coolant circuit of Westinghouse pressurized water reactors are discussed. (JWR)

26612 PRICE OF POWER: RADIOACTIVITY. Econ. Priorities Rep.; 3: No. 2, 16-19(May 1972).

An evaluation is presented of routine radioactive emissions and inherent risk interpreted in light of routine operation of commercial nuclear plants. Reviewed are such factors as AEC regulations, reactions that induce radioactivity, biological accumulation up the food chain, secondary processes as a source of radioactivity release, waste-treatment methods, and differences in views of various authorities on degree and acceptability of exposures. Availability of minimum release systems is noted. (NSIC)

26613 COMPARISON BETWEEN CODE CALCULATION AND BLOWDOWN EXPERIMENTS SIMULATING A LOSS-OF-COOLANT ACCIDENT IN A PRESSURIZED WATER REACTOR. Friz, G. (EURATOM Joint Research Centre, Ispra, Italy); Riebold, W.; Megnin, J. C.; Raynaud, A. Nucl. Eng. Des.; 25: No. 2, 193-206 (1973).

Within the reactor safety programme of the EURATOM Joint Research Centre at Ispra the transient heat transfer phenomena during depressurization are experimentally investigated under PWR conditions. The special closed loop DHT-1 essentially represents one subchannel and the upper and lower plenum of a pressurized water reactor. A test series simulating rupture in the hot leg of a primary cooling circuit was carried out. Pressure and test tube temperatures were measured at various rupture cross-sections. Independently from these experiments, a blowdown computer code was developed by the Groupement Atomique Alsacienne Atlantique (GAAA). The core part of this code allows calculation of the thermohydraulic history of the coolant within the core after a rupture in the primary cooling circuit. It has been checked with regard to the hypothesis and correlations applied; the experiments and calculations are compared. 18 references. (auth)

26614 ANALYSIS OF THE PREDISASSEMBLY PHASE OF THE UNPROTECTED OVERPOWER TRANSIENT ACCIDENT FOR LMFBRs. Kastenberg, W. E.; Rumble, E. T. (Kernforschungszentrum, Karlsruhe, Ger.). Nucl. Eng. Des.; 25: No. 2, 248-256 (1973).

A simplified model of the predisassembly phase for unprotected overpower transients in LMFBRs is presented. The model includes fuel movement and sodium expulsion as a result of the molten fuel–coolant thermal interaction in the channels. The SNR-300, a prototype demonstration plant, is analyzed and the results compared with an earlier set of calculations using the SAS–VENUS computational models. The previous analysis neglects fuel movement. The results indicate that substantial reductions in the severity of the transient as measured by molten fuel produced, the thermal energy generated and the final temperatures, can be obtained when fuel movement is included. 23 references. (auth)

Reactor Theory and Calculation

Refer also to abstracts 25327, 26099, 26182, and 26540.

26615 (BNWL-1757) MEASUREMENT OF TURBULENT VELOCITY, INTENSITY AND SCALE IN ROD BUNDLE FLOW CHANNELS CONTAINING A GRID SPACER. Rowe, D. S.; Chap-

man, C. C. (Battelle Pacific Northwest Labs., Richland, Wash.). Jun 1973. Contract AT(45-1)-1830. 95p. Dep. NTIS $5.45.

An experimental study was performed to evaluate the effect of grid spacers on the axial turbulent flow structure in a model rod bundle with a pitch-to-diameter ratio of 1.25. Experimental measurements were performed in water at a nominal Reynolds number of 100,000. Local axial velocity, turbulence intensity and Eulerian time correlations were measured at selected positions downstream from the spacer by using a laser-Doppler velocimeter. The results show that flow passing through the spacer emerges with increased axial turbulence intensity and decreased axial macroscale. The effect of the spacer on the turbulent structure was found to be weakly dependent on Reynolds number with decreased influence downstream from the spacer. With increased distance downstream from the spacer the axial macroscale increased monotonically to its fully developed values. The turbulence intensity for an interior channel varied significantly with distance downstream from the spacer. The high intensity observed at the trailing edge of the spacer rapidly decayed to values below the fully developed condition at a moderate distance from the spacer. Further downstream the level of intensity increased to nearly twice the level of intensity of fully developed flow before finally decaying to approximately the developed state. A qualitative analysis of the kinetic energy equation for turbulence indicated that the intermediate position of low intensity was probably due to a change from strongly nonisotropic turbulence at the spacer to nearly isotropic turbulence at the "quiet" position. Crossflow mixing estimates based on the product of axial intensity and scale would indicate reduced crossflow mixing downstream from the spacer. However, the inherent assumption of a constant ratio of Lagrangian lateral intensity and scale to the Eulerian axial intensity and scale is invalid for the developing flow downstream of the spacer. If the decrease of axial intensity is due to a change toward isotropy, the product of the lateral intensity and scale would probably not decrease. The net effect would not be a decrease but possibly an increase in crossflow mixing. (auth)

26616 (COO-1469-229) SECOND DERIVATIVE METHODS FOR THE SOLUTION OF STIFF ORDINARY DIFFERENTIAL EQUATIONS. Brown, R. L. (Illinois Univ., Urbana. Dept. of Computer Science). Aug 1973. Contract AT(11-1)-1469. 16p. (UIUCDCS-F-73-877) Dep. NTIS $3.00.

Stiff systems $y' = f(y,t)$ exist for which conventional numerical methods are inadequate. Implicit methods exist which are A-stable, A(α)-stable, or stiffly stable. Gear developed a method using stiffly stable formulas of maximum order 6; a Newton's iteration with the Jacobian matrix (df/dy) is used to get convergence of the method. Enright uses $(df/dy)(dy/dt) = (d^2y/dt^2)$ and the k previous derivatives $y'(t_{n-k})$ to obtain A(α)-stable formulas of maximum order 9. Formulas based on interpolation through $y'(t_n)$, $y''(t_n)$ and the k previous values $y(t_{n-k})$ are presented and shown to have maximum order 11. (auth)

26617 (COO-2262-3) GAKIN II: A ONE-DIMENSIONAL MULTIGROUP DIFFUSION THEORY REACTOR KINETICS CODE. Hansen, K. F.; Mason, J. H. (Massachusetts Inst. of Tech., Cambridge. Dept. of Nuclear Engineering). Aug 1973. Contract AT(11-1)-2262. 204p. (MITNE-151). Dep. NTIS $12.25.

Thesis. Submitted by J. H. Mason.

GAKIN II is a time dependent neutron diffusion code. It solves the time dependent multigroup neutron diffusion equations in one space dimension using the usual finite difference approximation. Time integration is accomplished using an exponential transformation and semi-implicit differencing. GAKIN II is a revision of the existing code GAKIN. The temporal treatment has been improved, a simplified and more implicit algorithm has been used, and the coding has been improved and simplified. 7 references. (auth)

26618 (COO-3052-5) VARIATIONAL DERIVATION OF MODAL-NODAL FINITE DIFFERENCE EQUATIONS IN SPATIAL REACTOR PHYSICS. Bailey, P. G.; Henry, A. F. (Massachusetts Inst. of Tech., Cambridge. Dept. of Nuclear Engineering). Jul 1972. Contract AT(11-1)-3052. 351p. (MITNE-138). Dep. NTIS $10.60.

Thesis. Submitted by P. G. Bailey.

A class of consistent coarse mesh modal-nodal approximation methods is presented for the solution of the spatial neutron flux in multigroup diffusion theory. The methods are consistent in that they are systematically derived as an extension of the finite element method by utilizing general modal-nodal variational techniques. Detailed subassembly solutions, found by imposing zero current boundary conditions over the surface of each subassembly, are modified by piecewise continuous Hermite polynomials of the finite element method and used directly in trial function forms. Methods using both linear and cubic Hermite basis functions are presented and discussed. The proposed methods differ substantially from the finite element methods in which homogeneous nuclear constants, homogenized by flux weighting with detailed subassembly solutions, are used. However, both schemes become equivalent when the subassemblies themselves are homogeneous. One-dimensional, two-group numerical calculations using representative PWR nuclear material constants and 18-cm subassemblies were performed using entire subassemblies as coarse mesh regions. The results indicate that the proposed methods can yield comparable if not superior criticality measurements, comparable regional power levels, and extremely accurate subassembly fine flux structure with little increase of computational effort in comparison with existing coarse mesh methods. 54 references. (auth)

26619 (EIR-240) MODIFIED VERSIONS OF THE TWO-DIMENSIONAL TRANSPORT THEORY METHOD DOIT. Maeder, C. (Eidgenoessisches Institut fuer Reaktorforschung, Wuerenlingen (Switzerland)). Jul 1973. 40p. Dep. NTIS (U. S. Sales Only) $4.00.

The discrete ordinate integrated technique DOIT developed recently at EIR solves the two-dimensional transport equation in x-y geometry. The DOIT method mitigates the ray effect and promises shorter running times compared to the widely used S_N codes. A deficiency of this method is a slight violation of the principle of neutron conservation. Two neutron-conserving modifications to DOIT are proposed. In the first approach the angular box boundary flux is calculated, as in the original method, but an additional assumption concerning the angular dependence of the outward directed fluxes is introduced. The second approach, which uses the perpendicular angular box boundary currents as unknowns, is based on the same assumptions as the original DOIT method. The results of check calculations indicate that this modification of the DOIT method is more attractive than either the original version or the first modification mentioned above. The transmission coefficients appearing in the theory are calculated by means of various two-dimensional integration formulas, and an expression for the source term is derived. (auth)

26620 (INDC(SEC)-31-U, pp 93-109) USE OF SPECTRUM MEASUREMENTS IN FAST MEDIA TO GET INFORMATION ON CROSS SECTIONS. Corcuera, P.; Govaerts, P.; L'Heriteau, J. P. Jan 1973.

In topical discussion on inelastic scattering of fast neutrons.

The neutron spectrum of a uranium assembly is measured with proton recoil detectors; the experimental spectrum is compared to the theoretical one. The discrepancies are mainly due to neutron inelastic scattering, and can be reduced by adjusting the cross sections. The influence of the spectrum of inelastically scattered neutrons is not so clear. (auth)

26621 (KFKI-73-23) DEVELOPMENT OF CORRELATION INSTRUMENTS AND MEASUREMENT TECHNIQUES WITH SPECIAL REGARD TO THE APPLICATION OF CORRELATION METHODS IN NEUTRON PHYSICS AND REACTOR TECHNIQUES. Final Report. Szlavik, F. (Magyar Tudomanyos Akademia Kozponti Fizikai Kutato Intezete, Budapest). Sep 1972. 79p. Dep. NTIS (U. S. Sales Only) $6.00.

The Final Report considers the N° 855/R1/RB Research Contract work conducted at the Institute from 1970 to 1972. The work can be grouped in five main directions each dealt with in a separate section. The fundamental background to the statistical investigations is covered by the two first sections, which discuss respectively developments in electronics and a special problem of the general theory of random processes. The third and fourth sections are devoted to two aspects of power reactor noise studies; firstly the theoretical treatment of special noise sources, and secondly, the experimental investigations on power reactor noise. The fifth section turns to a domain closely related to solid-state physics, that of correlation-type neutron spectroscopy. Separate abstracts are included for each of the five sections. (auth)

For abstracts of individual sections see: 24552, 24602, 24603, 26622, and 26673.

26622 (KFKI-73-23, pp 24-50) THEORETICAL STUDIES OF POWER REACTOR NOISE. Kosaly, G. (ed.). Sep 1972.

In development of correlation instruments and measurement techniques with special regard to the application of correlation methods in neutron physics and reactor techniques. Final report.

Some problems of power reactor noise are investigated via a two point model of heat transfer and one point reactor theory. The reactor response to inlet temperature fluctuations has been studied. It is shown that a peak which was predicted in the literature does not exist. The sink structure of the transfer function is examined in detail. The influence of inlet coolant temperature fluctuations and random mechanical vibrations of a control rod on the power spectral density of neutronic fluctuations is analyzed. The cross correlation function between coolant temperature fluctuations at two different axial positions is calculated. The behavior

of the correlation function is explained for different values of the relevant parameters. 19 references. (auth)

26623 (LA-5324-MS) REPORT OF THE SUBCOMMITTEE ON STANDARD INTERFACE FILES. Carmichael, B. M.; Meneley, D. A.; Vondy, D. (Los Alamos Scientific Lab., NM). Jul 1973. Contract W-7405-eng-36. 45p. Dep. NTIS $4.00.

This report was informally distributed originally to the Committee on Computer Code Coordination (CCCC) for Reactor Physics Codes. Because of several requests received, the report is reproduced herein. It contains the specifications for the standard interface data files developed by the CCCC for application to reactor physics codes. (auth)

26624 (LA-5367-MS) SERVICE MODULES FOR VERSION II STANDARD INTERFACE DATA FILES. Vigil, J. C. (Los Alamos Scientific Lab., N. Mex.). Aug 1973. Contract W-7405-eng-36. 59p. Dep NTIS $5.45.

A set of Version II standard data files has been specified by the Code Working Group to provide interfaces between reactor physics codes developed under the auspices of the Division of Reactor Research and Development. The service modules (input, print and file-retrieval processors) described in this report provide facilities for creating or modifying the data files from free-format card input, for selectively printing entire files or portions of files, and for transferring the files to and from permanent storage. The service modules are written entirely in standard FORTRAN to ease conversion to different types of computers. (auth)

26625 (RISO-286) MULTIGROUP CROSS SECTIONS FOR REACTOR PHYSICS CALCULATIONS, GENERATED ON THE BASIS OF FUNDAMENTAL NUCLEAR DATA. Hvidtfeldt Larsen, A. M. (Danish Atomic Energy Commission, Risoe. Research Establishment). Mar 1973. 61p. Dep. NTIS (U. S. Sales Only) $5.25.

The set-up of a cross section generating code system based on fundamental nuclear data is described. The basic source of data is the UK Nuclear Data Library containing cross section tabulations for most of the materials important in Reactor Physics Calculations. Effective resonance cross sections calculated from resonance parameters are added together with thermal scattering data. The applicability to light-water reactor systems of the group cross sections produced is demonstrated by means of calculationally simple test examples. (auth)

26626 ESTIMATION OF THE TIME DECAY CONSTANT. Ronen, Y. (Nuclear Research Centre-Negev, Beer-Sheva, Israel). Nucl. Sci. Eng.; 52: No. 1, 147-150(Sep 1973).

The functional analysis technique is applied for estimating upper bounds of changes in eigenvalues of integral equations. In particular, the method is used to determine the value of the time decay constant resulting from perturbations in a steady-state system. The method has no restrictive limitations as to the type of operator. The applications of this method are illustrated by examples from reactor theory. The effect of changes in cross sections of a fast system on the decay constant is studied. (auth)

26627 CRITICAL CONDITION. Siewert, C. E.; Burniston, E. E. (North Carolina State Univ., Raleigh). Nucl. Sci. Eng.; 52: No. 1, 150-151(Sep 1973).

The critical condition for a reflected spherical nuclear reactor is solved explicitly. (auth)

26628 OPTIMIZATION OF MATERIAL DISTRIBUTIONS IN FAST REACTOR CORES. Tzanos, C. P.; Gyftopoulos, E. P.; Driscoll, M. J. (Massachusetts Inst. of Tech., Cambridge). Contract AT(30-1)-4105. Nucl. Sci. Eng.; 52: No. 1, 84-94 (Sep 1973).

An iterative optimization method based on linearization and linear programming is developed. The method can be used for the determination of the material distributions in a fast reactor which maximize or minimize integral reactor parameters that are linear functions of the neutron flux and the material volume fractions. The method has been applied to the problems of optimization of the fuel distribution in a reactor of fixed power output, constrained power density, and constrained material volume fractions so as to obtain (a) a maximum initial breeding gain, (b) a minimum critical mass, and (c) a minimum sodium void reactivity. Under this realistic set of constraints, numerical results show that the same fuel distribution yields maximum breeding gain, minimum critical mass, minimum sodium void reactivity, and uniform power density. (auth)

26629 SINGULAR EIGENFUNCTION SOLUTION OF THE MONOENERGETIC NEUTRON TRANSPORT EQUATION FOR FINITE RADIALLY REFLECTED CRITICAL CYLINDERS. Westfall, R. M. (Lewis Research Center, Cleveland); Metcalf, D. R. Nucl. Sci. Eng.; 52: No. 1, 1-11(Sep 1973).

The normal mode expansion technique is applied to the transformed monoenergetic integral transport equation to develop a solution for the rotationally invariant and axially infinite critical two-region cylinder with a finite outer reflector boundary. The model assumes isotropic scattering and identical neutron mean-free-paths in the core and reflector regions. The solution in terms of singular integral equations is obtained by applying a completeness theorem found for the singular eigenfunctions. Numerical results for a variety of core and reflector multiplying properties and reflector thicknesses are presented and compared with the results of other methods. The completeness inherent in this solution and the high precision in the numerical calculations provide results which may be used as analytic standards for this problem. (auth)

26630 APPLICATION OF PHASE-SPACE FINITE ELEMENTS TO THE TWO-DIMENSIONAL NEUTRON TRANSPORT EQUATION IN X-Y GEOMETRY. Miller, W. F. Jr.; Lewis, E. E.; Rossow, E. C. (Northwestern Univ., Evanston, IL). Nucl. Sci. Eng.; 52: No. 1, 12-22(Sep 1973).

The finite element method is applied to the monoenergetic neutron transport equation in two-dimensional x-y geometry. A functional whose Euler equation is the second-order self-adjoint form of the transport equation is used in conjunction with four-dimensional space-angle phase-space finite elements to derive a set of simultaneous algebraic equations for the even-parity angular flux. Within each phase-space element, the continuous piecewise polynomial trial functions are bilinear in the angles and either linear or bilinear in the spatial variables. Elements that are both rectangular and triangular in the spatial variables are permitted with arbitrary orientation. Numerical results are presented to demonstrate the elimination of ray effects using the finite element method, and to illustrate the use of phase-space elements that are triangular in the spatial variables to effectively treat both hexagonal geometry and problems in which curved interfaces are present. (auth)

26631 TWO-DIMENSIONAL NEUTRON TRANSPORT CALCULATIONS USING THE RESPONSE MATRIX METHOD. Filippone, W. L. (Instituto Politecnico Nacional, Mexico City). Nucl. Sci. Eng.; 52: No. 1, 23-34(Sep 1973).

The response matrix technique is applied to two-dimensional slab problems and the results are compared with Monte Carlo calculations. It was found that the error due to the numerical treatment of the spatial distribution could be substantial. However, various corrections based on physical arguments were found which significantly improved the results. (auth)

26632 ESTIMATION OF TIME-VARYING REACTIVITY USING A METHOD OF NONLINEAR FILTERING. Shinohara, Y.; Oguma, R. (Japan Atomic Energy Research Inst., Tokai). Nucl. Sci. Eng.; 52: No. 1, 76-83(Sep 1973).

A simple method of nonlinear filtering is applied to the problem of dynamic reactivity estimation in which the law of reactivity change is assumed to be unknown. The filter is designed based on a system model containing the usual point reactor kinetics equations driven by fictitious white noises and a reactivity state equation. The latter is formulated such that the rate of the reactivity change is a random process, taking account of the unknown reactivity change. The nonlinear filter applied here is a simple modification of the Kalman filter added with a nonlinear feedback loop. The key parameter that determines the filter response is the parameter of the fictitious noise in the reactivity equation which is closely related to the filter gain. The results of the computer simulation and the experiment show that the nonlinear filter can be used to estimate the dynamic reactivity, even under an extremely noisy measurement condition. (auth)

26633 EQUIVALENCE RELATIONS IN BURN-UP OPTIMIZATION PROBLEMS. Zech, H. J.; Cimporescu, D. (Kernforschungszentrum, Karlsruhe, Ger.). Atomkernenergie; 21: No. 3, 179-182(1973).

Two new equivalence relations in burnup optimization problems are given and the conditions for a third relation, already known, are clarified. To prove these relations the Pontryagin maximum principle is applied. (GE)

26634 REACTOR THEORY OPERATIONS IN L_1 SPACE. Ronen, Y. (Israel Atomic Energy Commission, Beersheba). Atomkernenergie; 21: No. 3, 183-184(1973).

The suitability of applying the weighted L_1 space to reactor theory problems is briefly discussed, and bounds to reactor theory operators in this space are presented. (GE)

26635 EFFECT OF FUEL DENSITY OSCILLATIONS ON THE DYNAMIC CHARACTERISTICS OF AN EXTERNALLY MODERATED REACTOR. Blinkin, V. L.; Novikov, V. M. At. Energ. (USSR); 33: No. 2, 697(Aug 1972). (In Russian).

This paper was summarized as paper No. 598/6623 with full copy held by TIC.

Externally moderated reactors with gaseous cores are of interest for possible uses in MHD generators, power plants, etc. The compressibility of the fuel in such systems can exert an important effect on the dynamics of these reactors. For example cophasal oscillations of the fuel density in a multichannel reactor give rise to an additional dynamic reactivity. The effect of fuel density oscillations in the core of an externally moderated reactor on the reactor dynamics is analyzed. The problem is formulated in the age-diffusion approximation using the effective boundary conditions method with the time dependence determined by the fuel density oscillations. (auth)

26636 THEORY BEHIND THE "DOUBLE OVERCOMPENSATION" METHOD. Shishin, B. P. At. Energ. (USSR); 33: No. 4, 839-840(Oct 1972). (In Russian).

This paper was summarized as paper No. 611/6589 with full copy held by TIC.

The "double overcompensation" method is a way of determining the supercriticality of a nuclear reactor from the measured subcriticality (and vice versa) when the multiplying properties of the reactor are deliberately varied. A more rigorous validation of the method within the framework of a generalized arbitrary-critical model is presented. (auth)

26637 CALCULATION OF THE HEAT EXCHANGE IN CORE FLOW AND OF THE HYDRODYNAMICS IN LAMINAR FLOW OF COOLANTS IN REGULAR FUEL ELEMENT LATTICES. Subbotin, V. I.; Ushakov, P. A.; Zhukov, A. V.; Matyukhin, N. M. At. Energ. (USSR); 33: No. 4, 840-841(Oct 1972). (In Russian).

This paper was summarized as paper No. 612/6700 with full copy held by TIC.

Heat exchange for coolants with vanishingly small Prandtl numbers for a two-dimensional velocity profile is considered. A boundary value problem is substituted for the conjugate fuel element–coolant problem by introducing the generalized fuel element parameter ϵ_k. A linear system of equations has been derived for determining the coefficients of the Fourier series. (auth)

26638 NEUTRON TRANSPORT IN BOILING MEDIA. Rothman, G. P. (New South Wales Univ., Kensington, Australia). Atomkernenergie; 21: No. 2, 105-112(1973).

The formulation of an adequate description of the mean neutron population in the presence of boiling moderator or coolant is attempted. Starting from a framework of comprehensive stochastic descriptions, working equations are derived which show adequate corrections for boiling can be made of the approximate models currently used. Collision probability techniques are suitable but reciprocity relationships must be used with discretion; the internal structure of each boiling medium slab makes average (homogenized) reciprocity relations inexact. The detailed distribution of bubbles in a boiling system should be accounted for in accurate evaluations of criticality, especially where the bubbles are large. Evaluations of leakage, resonance escape probability and thermal absorption are modified by the detailed bubble distribution; examples of these modifications are given. The use of Monte Carlo techniques in calculating neutron transport in boiling media is discussed in some detail. A Monte Carlo formulation is presented, suitable for accurate analysis in a large bubble environment. (GE)

26639 ELASTIC SCATTERING PROBABILITY FUNCTIONS IN ARBITRARY COORDINATE SYSTEMS. Wienke, B. R. (Los Alamos Scientific Lab., NM). Nucl. Sci. Eng.; 51: No. 4, 508-511(Aug 1973).

The classical elastic scattering probability functions $f_s(v'_\mu, v_\mu)$, and corresponding speed and angular functions are simply generalized to any arbitrary coordinate system moving with velocity u. Unified consideration leads to new mixed, but equivalent, representations of $f_s(v'_\mu, v_\mu)$ which recover earlier results. The general treatment is concise and maintains the fundamental features of the binary collision in three dimensions. Extension of the analysis to anisotropic scattering is discussed briefly. (auth)

Reactor Components and Accessories

Refer also to abstracts 24430, 24922, 25201, 25234, 26480, 26651, and 26676.

26640 (CONF-721089-2) STRAIN GAGING NUCLEAR CONTAINMENT VESSELS. Grey, R. (Consolidated Test and Equipment, Inc., Redwood City, Calif. (USA)). 1972. 7p.

The processes and techniques developed for the instrumentation of concrete reinforcing and pressure liner steel with strain gages for Structural Integrity Testing of a nuclear power reactor containment vessel are described. The problems of making high quality strain gage installations under extremely adverse environmental and physical conditions, for operation over long periods, were resolved by the development of laboratory prepackaging procedures and application and adhesive thermal cure control.techniques. (auth)

26641 (CONF-730801-) SYMPOSIUM ON MATERIALS PERFORMANCE IN OPERATING NUCLEAR SYSTEMS, AMES, IOWA, AUGUST 28–30, 1973. Wechsler, M. S.; Smith, W. H. (eds.). (Ames Lab., Iowa). Aug 1973. 389p. Dep. NTIS $10.60.

Seventeen papers and two abstracts are included. Accounts are given of experience with materials under actual operating conditions in test, research, and power reactors and radioisotopic thermoelectric generators. Separate abstracts have been prepared for 12 of the papers; for abstracts of the remaining 5 papers, see NSA 27: 7920 and 28: 12128, 12156, 13177, and 20316. (DLC)

For abstracts of individual papers see: 25200–25202, 26471, 26472, 26489, 26490, 26501, 26513, and 26529–26531.

26642 (CONF-731003-1) SIMPLIFIED TOOL FOR THE ELEVATED TEMPERATURE CYCLIC ANALYSIS OF PRESSURE COMPONENTS. Chern, J. M.; Pai, D. H. (Foster Wheeler Corp., Livingston, N. J. John Blizard Research Center). 1972. 33p. Dep. NTIS $3.75.

From second international congress for pressure vessel and piping technology; San Antonio, Texas, USA (1 Oct 1973).

For Westinghouse Electric Corp., Madison, Pa. Advanced Reactors Div.

The results of a solution to the elastic-plastic-creep analysis of a long thick-walled cylinder under cyclic loading conditions which include time dependent internal/external pressure, radial thermal gradients, as well as axial tractions or displacements all of which can be applied in a non-proportional manner are described. An efficient program has been written to yield results at low computational cost, even for complicated load histories. The present version of the program incorporates the latest constitutive equations recommended for use in the procurement of United States Atomic Energy Commission test facility components. A detailed description of the solution scheme is given. Two illustrative examples are shown to demonstrate the utility of this program as a design tool in elevated temperature design for components subjected to repeated load histories. (auth)

26643 (IRS-T-24) REACTOR PROTECTION SYSTEM AS CENTRAL SAFETY ASSEMBLY IN NUCLEAR POWER PLANTS. 8th Discussion Meeting of IRS Experts, Cologne, 20-21 November 1972. (Technischer Ueberwachungs-Verein E. V., Cologne (West Germany). Institut fuer Reaktorsicherheit). Apr 1973. 147p. (In German). (CONF-721149-).

Separate abstracts are included for each of the 5 papers presented on power reactor protection systems. (DCC)

For abstracts of individual papers see: 26473, and 26644–26647.

26644 (IRS-T-24, pp 17-49) DESIGN FUNDAMENTALS OF REACTOR PROTECTION SYSTEMS. Stute, H. (Institut fuer Reaktorsicherheit, Cologne). Apr 1973. (In German).

The reactor safety system is shown to be a central safety device in nuclear power plants. The failure spectrum to be controlled by this system is presented. Single events to be considered in the design which may result in a failure of the safety system itself and fundamental measures for their control are discussed. The development of the term "reactor safety system" and its practical use, the resulting extent as well as importance and influence of the actuation and interlocking switch system design of the actuators frequently being characterized as part of the safety devices, are interpreted in connection with the reliability of the overall system. A contribution on the role of the reliability technique for the design of safety systems as well as a review on pertinent technical regulations conclude the work. (auth)

26645 (IRS-T-24, pp 50-63) TESTING OF REACTOR PROTECTION SYSTEMS IN THE LICENSING PROCEDURE. Reik, M. (Technischer Ueberwachungs-Verein Bayern, Munich); Becker, W.; Sommer, P.; Wegener, H. H. Apr 1973. (In German).

The safety assessment of reactor protection systems done by the Technischen Überwachungs-Vereine (TÜV) in the licensing procedure can be divided in several specific parts. These are

in detail the problems of checking the requirements and the preoperational field tests after the installation of the systems. Other checks are the maintenance and recurring inspections. The intended goals of the different checks are explained by use of examples. Some proposals are discussed which can help to improve the efficiency of the diverse checks. (auth)

26646 (IRS-T-24, pp 89-105) INFLUENCE OF NEW SAFETY CONSIDERATIONS IN THE DESIGN AND ARRANGEMENT OF PROTECTION SYSTEMS IN FUTURE NUCLEAR POWER PLANTS. Repke, W. (Kraftwerk Union A. G., Frankfurt am Main). Apr 1973. (In German).

According to the new requirements of the German licensee authorities to protect nuclear power plants against accidents like heavy earthquake, airplane crash and explosion pressure of chemical gas cloud, new considerations are necessary for design and arrangement of the reactor safety system. The results of these considerations will be the farther spacious separation, the bunkering of those parts which are necessary for the nuclear safety in each case, and the prevention of any influence from possibly disturbed parts to the sheltered parts of the reactor safety system. (auth)

26647 (IRS-T-24, pp 106-126) DEVELOPMENT TRENDS FOR REACTOR PROTECTION SYSTEMS. von Haebler, D. (Siemens A. G., Erlangen, Ger.); Schruefer, E. Apr 1973. (In German).

For the reactor protection systems used in the PWR manufactured in Germany detailed application is made of the systematics of error analysis. The now proven impulse technique has been introduced into the whole system. Circuit hardware is being perfected. AEG intends to install a computerized protection system in the boiling water reactor plants KKB and KKP. The investigations concerning the reliability of the hardware and the quality of the software done in the development of the computerized protection system are reviewed. (auth)

26648 (JPRS-60000) CHARACTERISTICS OF THE ELECTRICAL PART OF ATOMIC-ELECTRIC PLANTS. Fel'dman, M. L.; Chernovets, A. K. 11 Sep 1973. Translation of Osobennosti Elektricheskoi Chasti Atomnykh Elektrostantsii, Izdatel'stvo Energiya, Leningrad, 1972. 202p. NTIS.

A description of the main characteristics of the electrical parts of large modern atomic stations and their differences from the electrical parts of thermal electric power plants using organic fuel is presented. A brief characterization of the technological diagrams of promising types of nuclear plants is given. Reliability of power supplies is also discussed. (auth)

26649 ELEVATOR FOR A REACTOR WELL AND EQUIPMENT STORAGE AREA. Jones, C. R. (to Transfer Systems Inc.). U. S. Patent 3,744,593. 10 Jul 1973. Filed date 13 Apr 1971. 6p.

An elevator for a reactor well and an equipment storage area wherein a service platform is raised and lowered within the reactor well and adjoining area for performing operations within the reactor well and the equipment storage area. Toward this end, stationary tubes are suspended in fixed relation from an overhead support. Telescopically received by the stationary tubes are movable, upright tubes. Fixed to the lower ends of the movable tubes for rectilinear movement is the service platform. A lifting and lowering device, such as a cable and drum arrangement or a hydraulically actuated system, is mounted on the overhead support. The cables extend into the stationary tubes and are attached at their free ends to the movable tubes for raising and lowering the same, thereby raising and lowering the service platform. The movable tubes are spaced apart a distance slightly greater than the diameter of a reactor pressure vessel in the reactor well and a space is provided between the service platform and the adjacent superstructure of the refueling platform for the passage of equipment. (Official Gazette)

26650 PRESTRESSED CAST IRON REACTOR PRESSURE VESSEL (PCIPV). Schilling, F. E.; Beine, B. (Siempelkamp Giesserei KG, Krefeld, Ger.). Nucl. Eng. Des.; 25: No. 2, 315-319(1973).

The concept of the prestressed cast iron reactor pressure vessel (PCIPV) emerges from the utilization of cast iron in the design of radiation and thermal shields. The principles of construction are explained using a model which is at present being assembled. Salient differences between the proposed vessel concept and a prestressed concrete reactor pressure vessel (PCPV) are discussed. (auth)

26651 GENERAL THEORY FOR ELASTIC SOLIDS WITH TEMPERATURE-DEPENDENT MECHANICAL PROPERTIES. Fernandes, R.; Stouffer, D. C. (Univ. of Cincinnati). Nucl. Eng. Des.; 25: No. 2, 301-308(1973).

The linear theory of thermoelasticity is modified to include the case where the thermal and mechanical properties of the material depend on temperature. The study is motivated by a review of experimental data which clearly demonstrate that the properties of steel and aluminum vary significantly with moderate changes in temperature. The governing coupled equations are derived using the principles of mechanics and thermodynamics. The structure of the coupling between the temperature and strain rate is analyzed, and the requirements for uncoupling are discussed. The governing equations of the Airy stress function for thermal plane stress problems and the Helmholtz potential vector for three-dimensional problems are given. (auth)

26652 PRESTRESSED CONCRETE DEEP SLABS WITH OPENINGS. Karlsson, B. I. (Nylander and Hernelind, Konstruktionsbyra AB, Stockholm); Sozen, M. A. Nucl. Eng. Des.; 25: No. 2, 290-300(1973).

A series of small-scale models of prestressed concrete reactor vessels, with and without perforations in the end slab, were loaded to failure. All vessels failed in shear. The presence of penetrations did not decrease the strength of the end slab. The behavior of the vessels is described. Using a finite-element model, the stress conditions in the end slab at the failure load are evaluated. A method for calculating the shear strength of a deep slab is described. The method consists of three consecutive steps. First, calculate the load at which the inclined crack is initiated. Second, determine the shape of the load-carrying dome that is carved out inside the slab. Third, calculate and evaluate the stress conditions in the dome. 17 references. (auth)

26653 SAP: A STRUCTURAL ANALYSIS PROGRAM FOR LINEAR SYSTEMS. Wilson, E. L.; Bathe, K. J.; Peterson, F. E.; Dovey, H. H. (Univ. of California, Berkeley). Nucl. Eng. Des.; 25: No. 2, 257-274(1973).

The current version of the computer program SAP for the static and dynamic analysis of linear structural systems is described. The analysis capabilities of the program, the finite element library, the numerical techniques used, the logical construction of the program and storage allocations are discussed. The main advantages of the program as a general purpose code become apparent. Results of analyses as comparisons with other existing solutions are given, and running times which demonstrate the efficiency of the program are included. 28 references. (auth)

26654 QUALIFICATIONS OF INSTRUMENTS: AN OVERVIEW. Vellender, G. C. (Pioneer Service and Engineering Co., Chicago). Instrum. Power Ind.; 16: 17-24(1973).

From 16th annual symposium of the power industry; Chicago, Illinois, USA (23 May 1973). See CONF-730555-.

Critical instrumentation, used in nuclear power generating stations to ensure the public health and safety, requires qualification to assure its operation under extremes of environmental and seismic conditions. An overview of these requirements is presented. Problem areas and the activities of the technical societies in developing standards are reviewed. (auth)

26655 SEISMIC QUALIFICATION OF INSTRUMENTS FOR NUCLEAR POWER STATIONS. Maggio, R. J.; Meligi, A. E. (Sargent and Lundy Engineers, Chicago). Instrum. Power Ind.; 16: 25-34(1973).

From 16th annual symposium of the power industry; Chicago, Illinois, USA (23 May 1973). See CONF-730555-.

Techniques involved in qualifying Safety Category I instrumentation for nuclear power plant applications are described. The techniques are intended to meet the requirements of the various codes, standards, and safety guides considered in the evaluation and licensing of a nuclear power station. The discussion consists of various methods of presentation of seismic criteria and the implementation of the criteria into instrument specifications. Also, techniques for testing and presentation of data and reports showing instruments seismic qualifications are covered. Finally, consideration is given to the evaluation of seismic test data and reports. Environmental factors and Quality Assurance are discussed in brief to give an overall view of their role in the seismic qualification of instruments for nuclear power stations. 10 references. (auth)

26656 AEC ENVIRONMENTAL QUALIFICATION REQUIREMENTS FOR INSTRUMENTATION AT NUCLEAR POWER PLANTS. Sullivan, D. F. (Atomic Energy Commission, Washington, DC). Instrum. Power Ind.; 16: 41-44(1973).

From 16th annual symposium of the power industry; Chicago, Illinois, USA (23 May 1973). See CONF-730555-.

Protection system instruments located within the containments of nuclear power plants may be called upon to function while subjected to the severe environment resulting from the loss-of-coolant accident against which they are designed to protect. The require-

ments of the U. S. Atomic Energy Commission relating to the qualification of such instruments for use in these potential environments are discussed. Also discussed are several acceptable methods for implementing these requirements. (auth)

26657 EVALUATION OF THE SAFETY OF NUCLEAR COMPONENTS. Darnond, L.; Fritzsche, J.; Sarrate, M.; Wortman, O. (Comision Nacional de Energia Atomica, Buenos Aires). pp 236-240 of III Interamerican Conference on Materials Technology. Buenos Aires; Centro Regional de Ayuda Tecnica (1972). (In Spanish).

From 3rd inter-American conference on materials technology; Rio de Janeiro, Brazil (14 Aug 1972). See CONF-720832-.

The different ways of evaluating the capacity of a nuclear component to withstand work conditions, taking into account radiation damage, the effect of fatigue at low cycles, and the safety against fragile breaking are analyzed. Examples are given of the usual defects that appear in the construction of recipients and soldered heat exchangers and of the analysis that was carried out on the danger of these defects. (auth)

26658 APPLICATION OF ACOUSTIC DIAGNOSTICS IN NUCLEAR REACTOR OPERATION AND DEVELOPMENT. Continued and Concluded. Barclay, F. J. (Dounreay Experimental Reactor Establishment, Eng.); Hale, J. C.; Ledwidge, T. J.; Burton, E. H.; Jones, C. H. Ind. At. Spatiales; 16: No. 4, 23-34 (Jul 1972). (In French and English).

The results of certain acoustic diagnostics in nuclear reactors are reviewed. These techniques were used to study the Dounreay fast neutron reactor, the acoustic spectrum being determined at the beginning of the run in order to establish the void fraction in the liquid metal above the core, the electromagnetic cavitation (pump performance), and the cavitation inside the fuel elements; this technique was only partially successful in the localization of leaks in the primary circuit. Accelerometers were used for fuel failure diagnostics in the steam generating heavy water reactor (S.G.H.W.R.). The acoustic spectra of the BR3 Vulcain core, the pumps, and the fuel elements obtained with a series of accelerometers are also examined. The results of acoustic tests on the fuel elements of the modern British gas cooled reactor Mk-II are given. (FR)

26659 POWER SPECTRAL DENSITY AND COHERENCE FUNCTION ANALYSIS OF SAMPLED REACTOR PROCESS DATA USING HETERODYNE DIGITAL FILTERING TECHNIQUES. Seifritz, W.; Lindmo, T.; Roggenbauer, H. (OECD Halden Reactor Project, Norway). Energ. Nucl. (Milan); 20: No. 7, 385-399(Jul 1973).

A design procedure is presented for readily obtaining the digital algorithm for a computer code of a heterodyne auto power spectral density, cross power spectral density and coherence function analyzer using digital components as basic elements. As the basic mathematical tool for the design of the required digital low-pass filters in this system, the sophisticated method of the bilinear conformal transformation of the continuous s-domain onto the discrete z-domain has been stressed to generate recursive filter input–output difference equations. The digital arithmetic for the complete analyzer–consisting of a group of digital filters with contiguous passbands–has been implemented on a process computer and successfully applied to the analysis of reactor power noise investigations as well as to perturbation experiments. Simulation studies show that signals with frequencies up to 3 Hz can be analyzed on-line when the algorithm is coded in assembler, and the analysis is carried out for 20 chosen frequencies. 29 references. (auth)

26660 NUCLEAR REACTOR CORE MONITORING SYSTEM. Drummond, C. N.; Bybee, R. T.; Mason, F. L.; Worsham, H. J. Jr. U. S. Patent 3,751,333. 7 Aug 1973. Filed date 11 Jun 1970. 6p.

A nuclear reactor core monitoring system is described in which the neutron flux and/or temperature at locations along a passage extending through the core are sensed by detectors in an elongated instrumentation assembly inserted into the passage from a handling station outside the core region. The instrumentation assembly is laterally flexible so that it can negotiate bends in the passage. A hollow tube is included in the assembly for insertion therein of a standard neutron detector for periodically calibrating the other detectors. (Official Gazette).

Reactor Fuels

Refer also to abstracts 24424, 24553, 24929–24932, 24946, 24949, 24969, 24976, 24981, 25034, and 25040.

26661 (ORNL-TM-4113) TEMPERATURE DISTRIBUTION IN A 19-ROD SIMULATED LMFBR FUEL ASSEMBLY IN A HEXAGONAL DUCT (FUEL FAILURE MOCKUP BUNDLE 2A): RECORD OF EXPERIMENTAL DATA. Fontana, M. H.; MacPherson, R. E.; Gnadt, P. A.; Parsly, L. F.; Wantland, J. L. (Oak Ridge National Lab., Tenn.). Sep 1973. Contract W-7405-eng-26. 414p. AT.

A record of experimental data obtained from Fuel Failure Mockup bundle 2A, which simulated the configuration and power level of the Fast Test Reactor fuel is presented. Bundle 2A consisted of 19 electric cartridge heaters with outside diameters of 0.230 in. spaced by 0.056-in. wire wraps on a 12-in. pitch all enclosed in a hexagonal can. The purpose of this test series was to obtain thermal-hydraulic data for use in design of the Fast Test Reactor core. The report includes a description of the system and of the experimental procedures, a discussion of the data reduction procedures, and tabulated data from the 93 experiments performed in this series. (auth)

26662 DISCUSSION ON "A RELATIONSHIP FOR NON-CONSERVATIVE VOLUME CREEP UNDER DIFFERENT STATES OF STRESS", BY E. R. GILBERT AND J. L. STRAALSUND. Mosedale, D. (Dounreay Experimental Reactor Establishment, Thurso, Scotland). Nucl. Eng. Des.; 25: No. 2, 320-321(1973).

26663 HEAT TRANSFER IN TURBULENT LONGITUDINAL FLOW THROUGH UNBAFFLED ASSEMBLIES OF FUEL RODS. Pfann, J. (Nuclear Research Inst., Rez, Czech.). Nucl. Eng. Des.; 25: No. 2, 217-247(1973).

A numerical analysis of heat transfer in turbulent longitudinal flow through assemblies of unbaffled fuel rods is presented. The solution applies to triangular or rectangular arrays of fuel rods with fully developed velocity and temperature profiles, for fluids with Prandtl number ~ 1 and $\ll 1$. In the case of liquid metals, the thermal resistance of the cladding and bond are considered, but the turbulent heat transport component is neglected. For common liquids the circumferential turbulent heat transfer is considered. Results are compared in the range of dimensionless rod spacing of 1.0 – 1.6. Theoretical predictions and experimental results of other authors dealing with the problem show relatively good agreement. 20 references. (auth)

26664 LONGITUDINAL LAMINAR FLOW IN ASYMMETRICAL FINITE BUNDLES OF RODS. Chen, K. (National Tsing Hua Univ., Taiwan). Nucl. Eng. Des.; 25: No. 2, 207-216(1973).

Theoretical analysis is presented on the asymmetrical effects, i.e. peripheral displacement of rods or unequal rod diameters, on longitudinal laminar flow in a finite bundle of rods. Solution is by the method of superposition. Numerical results are obtained for shear stress and velocity distributions when only one rod is displaced in a seven rod cluster of equal-diameter rods. 8 references. (auth)

26665 STUDIES AND DEVELOPMENTS ON PLUTONIUM-BASE FUELS. Osuna, H. A.; Araoz, C.; Marticorena, J. O. (Comision Nacional de Energia Atomica, Buenos Aires). pp 789-793 of III Interamerican Conference on Materials Technology. Buenos Aires; Centro Regional de Ayuda Tecnica (1972). (In Spanish).

From 3rd inter-American conference on materials technology; Rio de Janeiro, Brazil (14 Aug 1972). See CONF-720832).

A program is described for the use of plutonium as a nuclear fuel. It consists of work carried out in three distinct areas. 1). Study of plutonium-base fuel materials. Studies have been planned on the possibility of the development of this type of fuel elements, as well as the understanding of their behavior. It includes the study of the properties of the mixed oxides, UO_2-PuO_2, with or without irradiation in regions of thermal conductivity, generation of fission gases, temperature distribution, etc. 2). Development of fabrication techniques. Work is being carried out on the preparation of irradiation capsules and fuel rods of the type Zircaloy–PuO_2–UO_2 for carrying out experiments for the understanding of materials and calculation models and for the preparation of demonstration prototypes. Likewise, various fabrication techniques are being studied that will be of use in a later step for this type of fuel. 3). Development of engineering for alpha-active materials. Also considered necessary is the development of specialized engineering for the design and construction of laboratories and special equipment essential for the accomplishment of this kind of work. The installation and construction of some especially designed equipment are described. The maximum participation of the national industry in this type of work is taken into account. (tr-auth)

26666 THERMAL CONDUCTIVITY OF PACKED BEDS IN-PILE. Leyers, H. J. (Kernforschungsanlage Juelich GmbH, Ger.). Atomkernenergie; 21: No. 3, 185-187(1973). (In German).

The behavior of thermal conductivity of packed beds under irra-

diation was investigated by measuring the integral thermal conductivity of an arrangement of loose coated particles, which could be the active part of a possible fuel-element for nuclear power stations. A satisfactory agreement was found between in-pile and out-of-pile measured values of the thermal conductivity. (GE)

26667 DEVICE FOR LOCATING CONSTITUENT ELEMENTS IN TURBID OR POLLUTED MEDIA. Vogt, F. (to INTERATOM). German Patent 1,812,087. 3 Sep 1970. Filed date 2 Dec 1968. (In German).

This device consists of a bundle of pins containing a large number of packet needles which serve as a guide rod in one or several perforated plates. (TSS)

Reactor Control Systems

Refer also to abstracts 24934, 24936, and 26604.

26668 (BNWL-B-297) PRELIMINARY SURVEY OF POTENTIAL FAST REACTOR CONTROL MATERIALS. Gray, W. J. (Battelle Pacific Northwest Labs., Richland, Wash.). Aug 1973. Contract AT(45-1)-1830. 15p. Dep. NTIS $4.00.

The advantages and disadvantages of B_4C, Ta, and the rare earths (RE) oxides as control materials are examined. The possible cost savings realized by using RE oxide rather than pure Eu_2O_3 are reported. From the standpoint of cost and availability, the (RE) oxide concentrates of Sm/Gd, Eu/Sm/Gd, and Eu in descending order, appear to be the best alternatives to pure Eu_2O_3 as fast reactor control materials, although the oxides of Tb, Dy, and Ho may also have potential. Because the reactivity worths of these materials cannot be determined with available cross section information, no estimate of the relative economic merits of these materials can be made. Since a 1000 MW(e) LMFBR would contain nearly one million dollars worth of pure Eu_2O_3 as control material, it appears that there may be potential for savings amounting to a few hundred thousand dollars per reactor. Cross sections and reactivity worths can be calculated for RE for ~$10,000 per element. It is recommended that such reactivity worth calculations be initiated. Sm and Gd should receive the highest priority although it would probably also be worthwhile to calculate the worths of Tb, Dy, and Ho on a somewhat lower priority basis. If the results of the worth calculations look favorable, a more detailed economic analysis, as well as studies of certain materials properties, should be performed. Materials properties that are of interest include the cubic-monoclinic transformation characteristics of RE oxide mixtures and an investigation to determine whether mixtures containing Sm_2O_3 tend to hydrate and, if so, whether this has any effect on the cubic-monoclinic transformations. The compatibility of the RE oxides with the cladding and the effect of reactor irradiation on the phase transformation, thermal conductivity, and dimensional stability should be studied. (auth)

26669 (GEAP-13824-1) LMFBR ALTERNATE SHUTDOWN SYSTEM DEVELOPMENT AND TESTING. First Quarterly Report, October 1971–March 1972. (General Electric Co., Sunnyvale, Calif. Breeder Reactor Dept.). May 1972. Contract AT(04-3)-189. 42p. Dep. NTIS $4.25.

The system design criteria (draft) submitted to RDT for approval are included. Nine design concepts are presented that will be evaluated along with additional concepts to select the recommended and fall-back concepts. Scoping analysis results show the fuel temperature rise as a function of various scram rates, safety system delay times, and accidental reactivity additions. 6 references. (auth)

26670 (GEAP-13824-2) LMFBR ALTERNATE SHUTDOWN SYSTEM DEVELOPMENT AND TESTING. Second Quarterly Report, April 1972–June 1972. (General Electric Co., Sunnyvale, Calif. Breeder Reactor Dept.). Jun 1972. Contract AT(04-3)-189. 68p. Dep. NTIS $5.50.

The initial screening of 27 various alternate shutdown system components is summarized. Six basic concepts are retained for further evaluation and consideration. The system design is discussed with respect to its classification, relationship to the primary shutdown system, and the logic design. A preliminary nuclear evaluation determined that the reactivity worth of the lithium manometer concept is sufficient to meet requirements. 7 references. (auth)

26671 (HEDL-TME-73-46) FLOW INDUCED VIBRATION TESTS OF A PROTOTYPIC FFTF CONTROL ROD ABSORBER PIN BUNDLE ASSEMBLY. Green, D. R.; Kinsel, W. C.; Fleming, D. M. (Hanford Engineering Development Lab., Richland, Wash.). Jun 1973. Contract AT(45-1)-2170. 36p. AT.

A full size 61 pin FFTF absorber assembly was tested at HEDL for hydraulic performance and flow-induced vibration. Tests were run in cold (75°F) water at 112 gpm nominal flow rate and at velocities ranging from 10% to 125% of nominal flow rates. Test results are presented. (auth)

26672 (HW-57046) 100-N DESIGN BASES. Part IV. Functional Requirements of the Nuclear Control and Safety Systems. Project CAI-816. Condotta, D. L.; Mansius, C. A.; Simpson, D. E. (General Electric Co., Richland, Wash. Hanford Atomic Products Operation). 16 Jun 1959. 35p. Dep. NTIS $3.00.

Declassified 4 Apr 1973.

The design bases for the control and safety systems and associated instrumentation for the N production reactor are summarized. (JWR)

26673 (KFKI-73-23, pp 51-61) EXPERIMENTAL POWER REACTOR NOISE STUDIES. Pallagi, D. (ed.). Sep 1972.

In development of correlation instruments and measurement techniques with special regard to the application of correlation methods in neutron physics and reactor techniques. Final report.

The initial aim of the power-reactor noise measurements was to establish the power-noise spectrum of the WWR-S reactor under normal operational conditions. Later, investigations were centered on the reliability of detecting bulk boiling by analysis of the noise deriving from core ionization chambers. The measuring arrangement and the results and conclusions drawn from these experiments are described. A recent problem is the determination by cross-correlation method of the cooling water velocity in given channels of the reactor core. The measuring arrangement and the results obtained are presented. 9 references. (auth)

26674 (MRR-121) EVALUATION OF RELIABILITY OF CIRCUITS FOR ACTUATING CONTROL ROD DRIVES. Nieckau, E. (Technische Universitaet Muenchen, Garching (West Germany). Laboratorium fuer Reaktorregelung und Anlagensicherung). Apr 1973. 82p. (In German). Dep. NTIS (U. S. Sales Only) $6.25.

A circuit for actuating a positioning driver unit as used in German reactor protection systems is described. Four fault-trees were drawn to determine the failure rates of this circuit. In order to show the dependence of the total failure rate from the failure rates of the electric components, two results for each failure mode were compared. It has been shown that the calculated failure rates of the electrical circuit (about 10^{-5} h^{-1}) for commands not carried out are of the same order of magnitude as the published values of positioning drivers. Finally, several suggestions for design rules and safety guides are made. (GE)

26675 PROCEEDINGS OF THE FIFTEENTH INTERNATIONAL ISA POWER INSTRUMENTATION SYMPOSIUM, DALLAS, TEXAS, MAY 22–24, 1972. Reitz, T. C. (ed.). Instrumentation in the Power Industry, Volume 15. Pittsburgh; Instrument Society of America (1972). 132p. (CONF-720595-).

Information is presented concerning power plant control systems, testing procedures, and personnel training. Of the 13 papers included, separate abstracts are presented for the 3 papers which have reference to nuclear power plants. (DCC)

For abstracts of individual papers see: 26498, 26681, and 26682.

26676 PROCEEDINGS OF THE SIXTEENTH INTERNATIONAL ISA POWER INSTRUMENTATION SYMPOSIUM, CHICAGO, ILLINOIS, MAY 23–25, 1973. Ralston, J. A. (ed.). Instrumentation in the Power Industry, Volume 16. Pittsburgh; Instrument Society of America (1973). 98p. (CONF-730555-).

Information is presented concerning power plant control systems and instrumentation. Of the 12 papers included, separate abstracts are presented for the 6 papers which have reference to nuclear power plants. (DCC)

For abstracts of individual papers see: 26654–26656, and 26678–26680.

26677 MEASUREMENTS OF SOLID VISCOSITIES AND DYNAMIC BEHAVIOUR OF A SPRING COLLIDING WITH A RIGID BODY. Suzuki, S. I. (Nagoya Univ., Japan). Nucl. Eng. Des.; 25: No. 2, 275-289(1973).

Introducing solid viscosities, the fundamental equation of motion of the spring is solved and the coefficients of solid viscosities are determined. Theoretical results are compared with experimental ones. The dynamic behavior of a spring in collision with a rigid body is investigated and the relationships between spring size, solid viscosities and dynamic load factors with respect to the force acting in the spring are obtained. 7 references. (auth)

26678 SUSQUEHANNA SES: ADVANCING NUCLEAR CONTROL ROOM TECHNOLOGY. Milam, W. G. (General Electric Co., San Jose, CA); Peterman, G. J.; Sulouff, M. D. Instrum. Power Ind.; 16: 1-8(1973).

From 16th annual symposium of the power industry; Chicago, Illinois, USA (23 May 1973). See CONF-730555-.

Nuclear plant control rooms have been characterized by long operating panels, large control switches, numerous large indicators and limited utilization of digital computers. To improve this technology, four conceptual control rooms were developed ranging from a conventional nuclear control room to a fully redundant computerized control room. For Pennsylvania Power & Light Company's first nuclear plant, Susquehanna Steam Electric Station, an intermediate blend of push-button control, miniaturization and advanced display techniques were set as goals for implementation. Specifications were written to describe this Advanced Control Room. After discussions with vendors, a control room design evolved which achieved the above goals resulting in compact panels, modular construction and a multi-processor minicomputer, information display system. (auth)

26679 SOME INSIGHT INTO ENVIRONMENTAL VERIFICATION OF PROCESS CONTROL SYSTEMS FOR NUCLEAR POWER PLANTS. Reid, J. B. (Westinghouse Electric Corp., Pittsburgh); Madera, E. J. Instrum. Power Ind.; 16: 35-40 (1973).

From 16th annual symposium of the power industry; Chicago, Illinois, USA (23 May 1973). See CONF-730555-.

To insure adequate protection of the public from any possible exposure to harmful levels of nuclear radiation, nuclear power generating stations must be designed to operate safely not only under normal operating conditions but also under possible extreme environmental conditions. The simulation of some of these extreme conditions and the testing which must be accomplished to verify the process control system for use in nuclear power plants are described. (auth)

26680 CONTROL COMPUTER APPLICATIONS IN ONTARIO HYDRO'S NUCLEAR STATIONS. Magagna, L. (Ontario Hydro, Toronto); Smith, J. E. Instrum. Power Ind.; 16: 65-74(1973).

From 16th annual symposium of the power industry; Chicago, Illinois, USA (23 May 1973). See CONF-730555-.

The computer control systems for the Pickering Power Reactor Units 1, 2, 3, and 4 and Bruce Power Reactor Units 1, 2, 3, and 4 are described. 10 references. (DCC)

26681 MODULAR CONTROL CONCEPTS FOR PANELBOARDS. McNulty, D. M. (United Engineers and Constructors Inc., Philadelphia). Instrum. Power Ind.; 15: 1-6(1972).

From 15th international instrumentation in the power industry; Dallas, Texas, USA (22 May 1972). See CONF-720595-.

The impact of environment, seismology, common mode failure, single failure criterion, reliability, testability, redundancy, Atomic Energy Commission safety guides and design criteria, and engineering society codes and standards have forced the power plant designer to take a new objective look at auxiliary system control techniques. A modular approach to packaging controls for pumps, fans, valves and distribution circuit breakers used in a large nuclear power plant is described. Power plant auxiliary system components are controlled by seven basic electrical circuits from control panels utilizing six generic type of information and/or control instruments. This repeated use of like components lends itself to application of mass production techniques. (auth)

26682 SPECIFYING TRAINING SIMULATORS FOR POWER PLANT OPERATORS. deMello, F. P.; Mills, R. J. (Power Technologies, Inc., Schenectady, NY). Instrum. Power Ind.; 15: 31-36(1972).

From 15th international instrumentation in the power industry; Dallas, Texas, USA (22 May 1972). See CONF-720595-.

The use of simulators for training power plant operators is an approach which is rapidly growing in popularity. However, the wide range of simulators available, in respect to both cost and function, often have a perplexing range of possibilities open to potential buyers. The various simulator options available are discussed in terms of size and type. Some critical design parameters in the context of the ability of the final system to meet the desired training goals are analyzed. 10 references. (auth)

Nuclear Power Plant Economics

Refer also to abstract 26773.

26683 (ORNL-TM-4289) DUAL-PURPOSE NUCLEAR DESALTING PLANT USING A LOW-TEMPERATURE EVAPORATOR. Jones, J. E. Jr. (Oak Ridge National Lab., Tenn.). Sep 1973. Contract W-7405-eng-26. 82p. Dep. NTIS $6.25.

A low-temperature vertical tube evaporator is evaluated and compared with a conventional high temperature VTE-MSF. In dual-purpose plants, low-temperature evaporators appear to have a favorable economic advantage because of lower heat cost, lower cost materials, such as aluminum, and lower feed treatment cost. The reference design is an all-aluminum 50 Mgd forward feed vertical tube evaporator with a single stage of flash feed heating per effect. Maximum brine temperature is 170°F. Water cost for the reference design is 41.3¢/1000 gallons compared with 49.4¢/1000 gallons for the high-temperature VTE-MSF which has a steel shell and uses copper-nickel heat transfer tubes. The major portion of the cost savings is in the cost of operation (heat, power, chemical, operating) where the low-temperature plant costs less than 20¢/1000 gallons to operate. (auth)

26684 ENERGY CRISIS IN THE US AND NUCLEAR HEAT. Grenon, M. Energy. Nucl. (Paris); 15: No. 2, 103-108(Mar 1973). (In French).

A brief review is given of the fuel situation in the United States: natural gas, petroleum, coal, and nuclear fuels. Problems associated with the direct utilization of nuclear heat are briefly reviewed: possibilities of installing plants, types of reactor, use of fuels, and the production of hydrogen. (FR)

26685 FUTURE POWER COSTS OF NUCLEAR POWER PLANTS. Brainbridge, G. Arch. Energiewirt.; 27: No. 14, 699-704(1973). (In German).

A forecast is given of the energy production and of the primary energy requirement (according to source) in Great Britain up to the year 2000. The reason for this growth in the share of nuclear energy is also given. The planned building of conventional and nuclear power plants in U. K. up to 1980 is reviewed. Taking the gas cooled reactors as an example, a comparison between nuclear and thermal power plants is drawn. The development of the energy costs with the load factor for nuclear power stations and conventional power stations is discussed. (GE)

26686 STEAM STORAGE ADDS PEAKING CAPACITY TO NUCLEAR PLANTS. Gilli, P. V.; Beckman, G. Energy Int.; 10: No. 8, 16-18(Aug 1973).

Peaking capacity can be built into a nuclear station economically by providing for storage of high-pressure steam at night which can be discharged at peak times through a separate power turbine. A comparison is made of peaking power and storage costs. The nuclear peak load plant with steam storage is shown to be competitive with pumped storage hydro plants and peak load gas turbine plants, except for stand-by capacity. (DLC)

Reactor Fuel Cycle Economics

Refer also to abstract 25274.

Reactor Licensing and Regulation

Refer also to abstracts 26645, 26646, and 26682.

26687 (DOCKET-50010-178) DRESDEN NUCLEAR POWER STATION, UNITS 1, 2, AND 3. Semiannual Operating Report No. 7, January 1–June 30, 1973. (Commonwealth Edison Co., Chicago, Ill.). 17 Aug 1973. 113p. (Docket-50237-349; Docket-50249-246). Dep. NTIS $7.75.

Operating reports for Dresden Units 1, 2, and 3 are combined in one document which is divided into three sections. Facility and procedural changes for each reactor are presented. (FS)

26688 (DOCKET-50171-126) PEACH BOTTOM ATOMIC POWER STATION, UNIT 1. Semiannual Operating Report No. 68, January 1–June 30, 1973. (Philadelphia Electric Co., PA). 11 Sep 1973. 39p. Dep. NTIS $4.00.

26689 (DOCKET-50219-288) OYSTER CREEK NUCLEAR POWER PLANT, UNIT 1. Abnormal Occurrence Report: Containment Spray System Failure. (Jersey Central Power and Light Co., Morristown, N. J.). 28 Jun 1973. 2p. Dep. NTIS $3.00.

26690 (DOCKET-50220-147) NINE MILE POINT NUCLEAR STATION, UNIT 1. Semiannual Operating Report No. 8, January 1–June 30, 1973. (Niagara Mohawk Power Corp., Syracuse, N. Y.). 27 Aug 1973. 47p. Dep. NTIS $4.50.

Net electric generation for the first half of 1973 totaled 1,366,864 MW hours with the Unit on load 58.7 percent of the period. Electric production for the six months was 51.5 percent of the 610 MW net registered electric capacity. A listing of reactor shutdowns and scrams is given and a narrative chronicle of Station Operations is given. The Station was shut down for refueling and general overhaul from April 14, 1973 through June 16, 1973. Details of the outage are included. (auth)

26691 (DOCKET-50220-155) NINE MILE POINT NUCLEAR STATION, UNIT 1. FAILURE OF AN ELECTROMATIC RELIEF VALVE TO CLOSE PROPERLY FOLLOWING MANUAL ACTUATION FROM THE CONTROL ROOM. (Niagara Mohawk Power Corp., Syracuse, N. Y.). 21 Jun 1973. 3p. Dep. NTIS $3.00.

26692 (DOCKET-50237-352) DRESDEN NUCLEAR POWER STATION, UNIT 2. Abnormal Occurrence Report; Failure of High Pressure Coolant Injection Valve MO-2-2301-3 to Open. (Commonwealth Edison Co., Chicago, Ill.). 24 Aug 1973. 3p. Dep. NTIS $3.00.

26693 (DOCKET-50244-182) ROBERT EMMETT GINNA NUCLEAR POWER PLANT, UNIT 1. Abnormal Occurrence 73-6 and 73-7: Failure of Sensing Line on "B" Auxiliary Feedwater Pump. (Rochester Gas and Electric Corp., N. Y.). 1 Aug 1973. 3p. Dep. NTIS $3.00.

26694 (DOCKET-50244-185) ROBERT EMMETT GINNA NUCLEAR POWER PLANT, UNIT 1. "B" STEAM GENERATOR FEEDWATER CONTROL VALVE FAILURE RESULTING IN REACTOR TRIP ON JULY 22, 1973. (Rochester Gas and Electric Corp., N. Y.). 21 Aug 1973. 57p.

26695 (DOCKET-50245-248) MILLSTONE NUCLEAR POWER STATION, UNIT 1. Unusual Occurrence, Leak in Containment Penetration Piping. (Millstone Point Co., Hartford, Conn.). 6 Aug 1973. 2p. Dep. NTIS $3.00.

26696 (DOCKET-50245-250) MILLSTONE NUCLEAR POWER STATION, UNIT 1. Semiannual Operating Report, January 1–June 30, 1973. (Millstone Point Co., Hartford, Conn.). 30 Aug 1973. 127p. Dep. NTIS $8.75.

On January 1, 1973, the plant remained shutdown as a result of the reactor coolant chemistry values exceeding technical specification limits on September 1, 1972. Final in-core work including refueling and replacement of 145 control rods was completed by mid-February. The reactor head closure was made and the dry-well leak rate test completed. The plant started up March 8 and ran for six weeks. On April 18 the plant was shutdown for in-service inspection. On April 24 this inspection revealed cracks in the feedwater spargers which had been installed in December 1972. Various feedwater flow tests were made using the steam separator as required. As a result of these flow tests and additional redesign, the vessel cladding was built up for feedwater sparger bracket installation. As of June 30, the clad build-up, brackets and four new feedwater spargers had been welded in place. Complete operation and maintenance summaries are followed by facility changes, promotions of key personnel, personnel radiation exposure records and short summaries of abnormal occurrences occurring in this period. (FS)

26697 (DOCKET-50245-254) MILLSTONE NUCLEAR POWER STATION, UNIT 1. Abnormal Occurrence AO-73-9: Error in the Reactor Level Instrumentation. (Millstone Point Co., Hartford, Conn.). 20 Aug 1973. 2p. Dep. NTIS $3.00.

26698 (DOCKET-50250-138) TURKEY POINT PLANT, UNITS 3 AND 4. Semiannual Operating Report No. 1, January 1–June 30, 1973. (Florida Power and Light Co.). 24 Aug 1973. 97p. (Docket-50251-127). Dep. NTIS $7.00.

Operation is reported for the period from January 1 to June 30, 1973, for Unit 3 and from June 11 (initial criticality) to June 30, 1973, for Unit 4. Unit 3 was still undergoing power escalation testing, up to 75% of rated power, during this period. The Unit was limited to 93% power because of Technical Specification limitation based on fuel densification. The practical limitation, however, was due to vibration of the main steam lines. This problem, which is discussed, limited unit power to about 77-80% power (550-600 MW(e)). The highest power reached was 672 MW(e) (about 88% of rated power) on April 11. Unit 4 was undergoing low power physics testing and power escalation testing during the period. The highest power reached was 240 MW(e) (about 42% of rated power) on June 30, 1973. Results of surveillance tests and inspections; containment leak rate tests; changes in design, key personnel, and procedures; and changes, tests, and experiments requiring prior AEC approval are presented. (FS)

26699 (DOCKET-50250-139) TURKEY POINT PLANT, UNIT 3. Abnormal Occurrence No. 3-73-8: Rod Control Cluster Assembly J-5 Stuck. (Florida Power and Light Co). 28 Aug 1973. 3p. Dep. NTIS $3.00.

26700 (DOCKET-50251-129) TURKEY POINT PLANT, UNIT 4. Abnormal Occurrence No. 4-73-10: Insertion of Part Length Control Rods. (Florida Power and Light Co.). 23 Aug 1973. 4p. Dep. NTIS $3.00.

26701 (DOCKET-50254-218) QUAD-CITIES STATION, UNITS 1 AND 2. Semiannual Operating Report, January 1–June 30, 1973. (Commonwealth Edison Co., Chicago, Ill.). 27 Aug 1973. 79p. (Docket-50265-212). Dep. NTIS $6.00.

The operations summary including chronological histories, surveillance and leak tests, and operating and procedural changes is presented. Power generation, shutdowns, maintenance, changes, tests, experiments, and personnel occupational radiation exposure are described. (FS)

26702 (DOCKET-50255-169) PALISADES NUCLEAR PLANT. Semiannual Operating Report No. 5, January 1–June 30, 1973. (Consumers Power Co., Jackson, Mich.). 31 Aug 1973. 581p. Dep. NTIS $31.25.

26703 (DOCKET-50255-171) PALISADES PLANT. Failure of Motor Operator of Concentrated Boric Acid Pump Feed Stop Valve, August 21, 1973. (Consumers Power Co., Jackson, MI). 29 Aug 1973. 2p. Dep. NTIS $3.00.

26704 (DOCKET-50259-104) BROWNS FERRY NUCLEAR POWER STATION, UNIT 1. Abnormal Occurrence BFAO-735W: Details Concerning the Failure of a Pressure Switch. (Tennessee Valley Authority, Chattanooga). 23 Aug 1973. 2p. Dep. NTIS $3.00.

26705 (DOCKET-50259-105) BROWNS FERRY NUCLEAR POWER STATION, UNIT 1. Abnormal Occurrence BFAO-736W: Describes the Malfunction of a Level Switch. (Tennessee Valley Authority, Chattanooga). 24 Aug 1973. 2p. Dep. NTIS $3.00.

26706 (DOCKET-50259-113) BROWNS FERRY NUCLEAR POWER STATION, UNIT 1. Environmental Abnormal Occurrences Nos. BFEAO-731W, -737W, -738W, -739W, -7310W, and 7311W: Fish Killed When Impinged on Intake Screens. (Tennessee Valley Authority, Chattanooga). 19 Sep 1973. 6p. Dep. NTIS $3.00.

26707 (DOCKET-50261-208) H. B. ROBINSON, UNIT 2. Failure of Reactor Trip From Turbine Trip. (Carolina Power and Light Co., Raleigh, N. C.). 27 Jun 1973. 2p. Dep. NTIS $3.00.

26708 (DOCKET-50261-209) H. B. ROBINSON, UNIT 2. Abnormal Occurrence of April 10, 1973: Information to Assist in the Evaluation of Uncontrolled Release of Radioactive Liquids. (Carolina Power and Light Co., Raleigh, N. C.). 29 Jun 1973. 13p. Dep. NTIS $3.00.

26709 (DOCKET-50266-117) POINT BEACH NUCLEAR PLANT, UNITS 1 AND 2. Semiannual Operating Report No. 6, January 1–June 30, 1973. (Wisconsin Electric Power Co., Milwaukee). 28 Aug 1973. 105p. (DOCKET-50301-102). Dep. NTIS $7.50.

Reactor construction; operation including procedures shutdowns, and tests; maintenance; instrumentation and control; chemistry; health physics and safety; six abnormal occurrences; twenty-one design changes; plant performance; and environment are summarized. The abnormal occurrences included two unscheduled activity releases, violation of containment integrity, unmonitored letdown line, exceeding hot channel factor limits, and miscalibration of high steam flow trip set points. Design changes were made to steam lines, facade drain piping, valves, steam generator valves, boric acid recirculation, pressurizers, turbine oil lube system, switches on containment access, steam generator feed pumps, power indication meter, coolant drain valves, chemical pump timers, instrument air compressors, steel plates on cable room doors, blowdown evaporator, and the vacuum control system. (FS)

26710 (DOCKET-50269-125) OCONEE NUCLEAR STATION, UNIT 1. Abnormal Occurrence No. AO-269/73-5, Failure to Verify Operability of Reactor Building Spray Pump 1B After Maintenance. (Duke Power Co., Charlotte, N. C.). 7 Sep 1973. 3p. Dep. NTIS $3.00.

26711 (DOCKET-50271-194) VERMONT YANKEE NUCLEAR POWER STATION. Abnormal Occurrence No. AO-73-25, Lighting Strikes Top of Plant Ventilation Stack Resulting in Failure of Monitoring Systems. (Vermont Yankee Nuclear Power Corp., Rutland). 7 Sep 1973. 3p. Dep. NTIS $3.00.

26712 (DOCKET-50281-129) SURRY POWER STATION, UNIT 2. RO Inquiry Report No. 73-1Q, Unplanned Radioactivity Release, February 18, 1973. (Virginia Electric and Power Co., Richmond). 28 Jun 1973. Dep. NTIS $3.00.

A radioactivity release caused by improper valve positions between Unit 2 and the gaseous radwaste system shared with Unit 1 is described. (JNR)

26713 (DOCKET-50281-130) SURRY POWER STATION, UNIT 2. RO Inquiry Report No. 73-2Q, Emergency Diesel Generator Failure, March 14, 1973. (Virginia Electric and Power Co., Richmond). 28 Jun 1973. 5p. Dep. NTIS $3.00.

26714 (DOCKET-50281-132) SURRY POWER STATION, UNIT 2. Abnormal Occurrence Report No. AO-S2-73-06, Failure of Containment Spray Pump Discharge Valve. (Virginia Electric and Power Co., Richmond). 17 Jul 1973. 7p. Dep. NTIS $3.00.

26715 (DOCKET-50285-103) FORT CALHOUN STATION, UNIT 1. Abnormal Occurrence Report: Unintentional Reduction in Shutdown Margin on August 3, 1973. (Omaha Public Power District, Nebr). 16 Aug 1973. 4p. Dep. NTIS $3.00.

26716 (DOCKET-50295-141) ZION STATION, UNITS 1 AND 2. Radiological Safety Technical Specifications, Appendix A. (Commonwealth Edison Co., Chicago, Ill.). 1973. 379p. (Docket-50304-106). Dep. NTIS $21.00.

26717 (DOCKET-50315-130) DONALD C. COOK NUCLEAR PLANT, UNITS 1 AND 2. Draft Environmental Statement by DRL, December 1972. (Directorate of Licensing (AEC), Washington, D.C.). Dec 1972. 256p. (DOCKET-50316-127). Dep. NTIS $15.00.

26718 (DOCKET-50315-135) DONALD C. COOK NUCLEAR PLANT, UNITS 1 AND 2. Safety Evaluation. (Directorate of Licensing (AEC), Washington, D. C.). 10 Sep 1973. 238p. (DOCKET-50316-131). Dep. NTIS $14.00.

26719 (DOCKET-50348-63) JOSEPH M. FARLEY NUCLEAR PLANT, UNITS 1 AND 2. Revised License Application. (Alabama Power Co., Birmingham). 29 Aug 1973. 98p. (Docket-50364-51). Dep. NTIS $7.00.

26720 (DOCKET-50348-64) JOSEPH M. FARLEY NUCLEAR PLANT, UNITS 1 AND 2. Environmental Report, Operating License Stage. (Alabama Power Co., Birmingham). 29 Aug 1973. 368p. (Docket-50364-52). Dep. NTIS $20.50.

The environmental effects of construction and operation of the Joseph M. Farley Nuclear Plant, Units 1 and 2 are examined. The descriptions include: the environment in the area, including the history, geography, geology, hydrology, climatology, ecology, land and water use including chemical characteristics; the facility and its effluents; the impacts from construction and operation of the facility; alternatives to the proposed action; irreversible and irretrievable long-term commitments of resources from plant operation; need for power; and the benefits–cost analysis of the proposed plant operation. (FS)

26721 (DOCKET-50348-65) JOSEPH M. FARLEY NUCLEAR PLANT, UNITS 1 AND 2. Environmental Report, Operating License Stage, Appendix 1 and 2. (Alabama Power Co., Birmingham). 29 Aug 1973. 230p. (Docket-50364-53). Dep. NTIS $13.50.

26722 (DOCKET-50348-66) JOSEPH M. FARLEY NUCLEAR PLANT, UNITS 1 AND 2. License Application, FSAR, Volume 1. (Alabama Power Co., Birmingham). 29 Aug 1973. 497p. (Docket-50364-54). Dep. NTIS $27.00.

The application for an operating license for a power plant consisting of two nuclear units, each at a rated power level of 2625 MW(t), is presented. The power plant is described and compared with similar facilities. Agents and contractors are named. The geography, meteorology, hydrology, geology, and seismology of the site are described and nearby facilities are discussed. (FS)

26723 (DOCKET-50348-67) JOSEPH M. FARLEY NUCLEAR PLANT, UNITS 1 AND 2. License Application, FSAR, Volume 2. (Alabama Power Co., Birmingham). 29 Aug 1973. 421p. (Docket-50364-55). Dep. NTIS $23.25.

Site characteristic appendices including the selection of temperature difference categories to define Pasquill stability categories based on data collected at the site and site subsurfaces and foundations are presented. (FS)

26724 (DOCKET-50348-68) JOSEPH M. FARLEY NUCLEAR PLANT, UNITS 1 AND 2. License Application, FSAR, Volume 3. (Alabama Power Co., Birmingham). 29 Aug 1973. 225p. (Docket-50364-56). Dep. NTIS $13.25.

Information is presented concerning the conformance with AEC design criteria; classification of structures, components, and systems; wind and tornado loadings; missile protection; protection against dynamic effects of pipe rupture, and seismic effects. (FS)

26725 (DOCKET-50348-69) JOSEPH M. FARLEY NUCLEAR PLANT, UNITS 1 AND 2. License Application, FSAR, Volume 4. (Alabama Power Co., Birmingham). 29 Aug 1973. 407p. (Docket-50364-57). Dep. NTIS $22.50.

Seismic design, design of Category 1 structures, mechanical systems and components, seismic design of Category 1 instruments and electrical equipment, environmental design of mechanical and electrical equipment are presented with appendices describing conformance with AEC guides, containment proof tests, mechanical splicing reinforcing bar using the Cadweld process, justification for load factors and combinations used in containment design equations, justification for capacity reduction factors used in determining containment capacity, computer programs used in structural analysis, QA procedures for field welding and nondestructive tests of liner plates, containment structural acceptance tests, liner plate stability, and an assessment of containment structure post tensioning system surveillance program. (FS)

26726 (DOCKET-50348-70) JOSEPH M. FARLEY NUCLEAR PLANT, UNITS 1 AND 2. License Application, FSAR, Volume 5. (Alabama Power Co., Birmingham). 29 Aug 1973. 511p. (Docket-50364-58). Dep. NTIS $27.75.

Information is presented on the mechanical, nuclear, thermal, and hydraulic design of the reactor. The integrity of the reactor coolant pressure boundary, thermal hydraulics system, reactor vessel and appurtenances and the component and subsystem designs are described. (FS)

26727 (DOCKET-50348-71) JOSEPH M. FARLEY NUCLEAR PLANT, UNITS 1 AND 2. License Application, FSAR, Volume 6. (Alabama Power Co., Birmingham). 29 Aug 1973. 556p. (Docket-50364-59). Dep. NTIS $30.00.

The engineered safety features including the containment systems, ECCS, habitability system and the auxiliary feedwater system are described and the compatibility of materials is reviewed. Data is presented concerning the design of trip and actuation systems, systems required for safe shutdown, safety related display instrumentation, other safety systems, and control systems not required for safety. (FS)

26728 (DOCKET-50348-72) JOSEPH M. FARLEY NUCLEAR PLANT, UNITS 1 AND 2. License Application, FSAR, Volume 7. (Alabama Power Co., Birmingham). 29 Aug 1973. 229p. (Docket-50364-60). Dep. NTIS $13.50.

The onsite and offsite electric power supply systems are described. (FS)

26729 (DOCKET-50348-73) JOSEPH M. FARLEY NUCLEAR PLANT, UNITS 1 AND 2. License Application, FSAR, Volume 8. (Alabama Power Co., Birmingham). 29 Aug 1973. 551p. (Docket-50364-61). Dep. NTIS $29.75.

Auxiliary systems, which include the fuel storage and handling, water systems, process auxiliaries, air conditioning, heating, cooling, and ventilation, are described. The steam and power conversion system, including the turbogenerator and the main steam supply lines, is presented. (FS)

26730 (DOCKET-50348-74) JOSEPH M. FARLEY NUCLEAR PLANT, UNITS 1 AND 2. License Application, FSAR, Volume 9. (Alabama Power Co., Birmingham). 29 Aug 1973. 498p. (Docket-50364-62). Dep. NTIS $27.00.

Liquid, solid, and gaseous waste management including radiological monitoring of process effluents and off-site monitoring are explained. The shielding, ventilation and health physics program are described. Conduct of operations is presented including descriptions of the organization, training program, emergency planning, review and audit, and plant reporting. (FS)

26731 (DOCKET-50348-75) JOSEPH M. FARLEY NUCLEAR PLANT, UNITS 1 AND 2. License Application, FSAR, Volume 10. (Alabama Power Co., Birmingham). 29 Aug 1973. 529p. (Docket-50364-63). Dep. NTIS $28.50.

Test programs, augmentation of the staff for initial tests and operation, normal operation, faults of moderate frequency, infrequent faults and limiting faults are described. (FS)

26732 (DOCKET-50348-76) JOSEPH M. FARLEY NUCLEAR PLANT, UNITS 1 AND 2. License Application, FSAR, Volume 11. (Alabama Power Co., Birmingham). 29 Aug 1973. 400p. (Docket-50364-64). Dep. NTIS $22.00.

Technical specifications including definitions, safety limits and limiting safety system settings, limiting conditions for operations, surveillance requirements, design features, and administrative controls are presented. The quality assurance program during design, construction and operation is explained. (FS)

26733 (DOCKET-50389-21) ST. LUCIE PLANT, UNIT 2. Environmental Report, Volume 1. (Florida Power and Light Co.). 31 Aug 1973. 365p. Dep. NTIS $20.25.

The environmental effects of construction and operation of the

St. Lucie Plant, Unit 2 are examined. The descriptions include: the environment in the area, including the history, geography, geology, hydrology, climatology, ecology, land and water use including chemical characteristics; the facility and its effluents; the impacts from construction and operation of the facility; alternatives to the proposed action; irreversible and irretrievable long-term commitments of resources from plant operation; need for power; and the benefits–cost analysis of the proposed plant operation. (FS)

26734 (DOCKET-50389-22) ST. LUCIE PLANT, UNIT 2. Environmental Report, Volume 2. (Florida Power and Light Co.). 1973. 348p. Dep. NTIS $19.50.

26735 (DOCKET-50390-38) WATTS BAR NUCLEAR PLANT, UNITS 1 AND 2. Evaluation of Methods of Computation of Maximum Transient Pressures, Differential Pressures, and Loads for Ice Condenser Containment Systems. (Battelle Pacific Northwest Labs., Richland, Wash.). 18 May 1973. 101p. (DOCKET-50391-38). Dep. NTIS $7.25.

For Tennessee Valley Authority, Chattanooga and Duke Power Co., Charlotte, NC.

Methods of computation of the maximum transient pressure, differential pressures, and loads for the ice condenser concept in which a large mass of ice is utilized to condense escaping high energy steam in a LOCA or a steam line break, are evaluated. The TMD computer program is found to be a reasonable and conservative simulation of short-term containment response to short term loss of coolant accidents. The use of SATAN V for the transient mass flow and enthalpy inputs to TMD is substantially conservative for computing peak compartment pressure, differential pressure, and mass flow rates. The TMD program overpredicts peak pressure, differential pressure, and flow induced loads compared to those which would occur in an actual plant accident situation. (FS)

26736 (DOCKET-50409-60) LA CROSSE BOILING WATER REACTOR. Monthly Operating Report, June 1973. (Dairyland Power Cooperative, La Crosse, Wis.). 1973. 27p. (DPC-851-61). Dep. NTIS $3.50.

The maintenance, fabrication, receipt and installation of two neutron source holders and fuel loading were completed. A plant startup was conducted on June 25. For the month the reactor was critical 93.1 hours and the turbine-generator connected to the DPC grid for 42.2 hours. One scram occurred at power due to a malfunction of the seal of the injection system. The major maintenance items completed were as follows: installation of the flow control valves on the emergency core spray bundle and flows set on each valve, overhaul of control rod effluent pump 1B, replaced bearings in the purification pump, inspected reactor vessel internals with underwater television camera, installed emergency core spray bundle, installed reactor vessel head and associated piping, plugged all failed fuel element detection system lines at reactor vessel head due to numerous fitting leaks, conducted reactor vessel and piping leak test at 1440 psig, and installed new insulation on forced circulation pump 1B casing. (auth)

26737 (DOCKET-50412-27) BEAVER VALLEY POWER STATION, UNIT 2. License Application, PSAR, Amendment 9. (Duquesne Light Co., Pittsburgh, PA). 20 Aug 1973. 622p. Dep. NTIS $33.25.

26738 (DOCKET-50416-42) GRAND GULF NUCLEAR STATION, UNITS 1 AND 2. Final Environmental Statement, August 1973. (Directorate of Licensing (AEC), Washington, D. C.). Aug 1973. 481p. (Docket-50417-42). Dep. NTIS $26.25.

26739 (DOCKET-50445-1) COMANCHE PEAK STEAM ELECTRIC STATION, UNITS 1 AND 2. License Application. (Texas Utilities Generating Co., Dallas (USA)). 18 Jul 1973. 122p. (Docket-50446-1). Dep. NTIS $8.25.

Financial data for the applicants of the two 3411 MW(t) pressurized water reactors to be located in Somervell County, Texas, 65 air miles southwest of the Dallas–Fort Worth area are presented. (FS)

26740 (DOCKET-50445-6) COMANCHE PEAK STEAM ELECTRIC STATION, UNITS 1 AND 2. Preliminary Safety Analysis Report, Volume 5. (Texas Utilities Generating Co., Dallas (USA)). 18 Jul 1973. 384p. (Docket-50446-6). Dep. NTIS $21.25.

Safety analyses concerning auxiliary systems; steam and power conversion, liquid, gaseous, and solid radioactive waste management, and radiological monitoring of process and effluent streams, and off site radiological monitoring are presented. (FS)

26741 (DOCKET-50448-11) DOUGLAS POINT NUCLEAR GENERATING STATION, UNITS 1 AND 2. Environmental Report, Construction Permit Stage, Volume 1. (Potomac Electric Power Co., Washington, D. C. (USA)). 8 Aug 1973. 458p. (DOCKET-50449-11). Dep. NTIS $25.10.

The environmental effects of construction and operation of the Douglas Point 1 and 2 reactors are examined. The descriptions include: the environment in the area, including the history, geography, geology, hydrology, climatology, ecology, land and water use including chemical characteristics; the facility and its effluents; the impacts from construction and operation of the facility; alternatives to the proposed action; irreversible and irretrievable long-term commitments of resources from plant operation; need for power; and the benefits–cost analysis of the proposed plant operation. (FS)

26742 (DOCKET-50448-12) DOUGLAS POINT NUCLEAR GENERATING STATION, UNITS 1 AND 2. Environmental Report, Construction Permit Stage, Volume 2. (Potomac Electric Power Co., Washington, D. C. (USA)). 8 Aug 1973. 416p. (DOCKET-50449-12). Dep. NTIS $23.00.

26743 (DOCKET-50448-13) DOUGLAS POINT NUCLEAR GENERATING STATION, UNITS 1 AND 2. Environmental Report, Construction Permit Stage, Volume 3. (Potomac Electric Power Co., Washington, D. C. (USA)). 8 Aug 1973. 468p. (DOCKET-50449-13). Dep. NTIS $25.60.

Information concerning the power requirements for a regional mass transit system, a terrestrial ecology survey of the site, and an aquatic survey of the Potomac River at Douglas Point are presented. (FS)

26744 (DOCKET-50448-14) DOUGLAS POINT NUCLEAR GENERATING STATION, UNITS 1 AND 2. Environmental Report, Construction Permit Stage, Volume 4. (Potomac Electric Power Co., Washington, D. C. (USA)). 8 Aug 1973. 572p. (DOCKET-50449-14). Dep. NTIS $30.80.

Information is presented concerning a mathematical model for the calculation of a visible plume; a salt drift model; analytical models for environment cost estimates of aquatic populations; a dye tracer study; mathematical model for radiological impact analysis; basic data for BWR source term calculations; PJM interconnection operating instructions; incremental cost analysis of the site; biological impact of three alternative cooling systems at three proposed power plant sites; comparison of potential impact on population for three candidate power plant sites; survey of land use, transmission line impact of three potential sites; evaluation of two plant sites for once through cooling; and the availability and future price levels of low-sulfur fuels for a 2200 MW(e) station in Maryland. (FS)

26745 (DOCKET-50448-15) DOUGLAS POINT NUCLEAR GENERATING STATION, UNITS 1 AND 2. Application for Licenses, August 8, 1973. (Potomac Electric Power Co., Washington, D. C. (USA)). 8 Aug 1973. 61p. (DOCKET-50449-15). Dep. NTIS $5.25.

26746 (DOCKET-50448-16) DOUGLAS POINT NUCLEAR GENERATING STATION, UNITS 1 AND 2. Antitrust Review Information. (Potomac Electric Power Co., Washington, D. C. (USA)). 8 Aug 1973. 37p. (DOCKET-50449-16). Dep. NTIS $4.05.

26747 (DOCKET-50450-2) SUMMIT POWER STATION, UNITS 1 AND 2. License Application. (Delmarva Power and Light Co., Wilmington, De. (USA)). 30 Apr 1973. 85p. (DOCKET-50451-2). Dep. NTIS $6.25.

Financial data of the applicants for two 770 MW(e) HTGR reactors to be located at a site in New Castle County near Summit, Delaware are presented. (FS)

26748 (DOCKET-50452-4) GREENWOOD ENERGY CENTER, UNITS 2 AND 3. Applicant's Environmental Report, Construction Permit Stage, Volume 1. (Detroit Edison Co., Mich.). 12 Sep 1973. 853p. (DOCKET-50453-4). Dep. NTIS $44.75.

The environmental effects of construction and operation of the Greenwood Energy Center, Units 2 and 3 are examined. The descriptions include: the environment in the area, including the history, geography, geology, hydrology, climatology, ecology, land and water use including chemical characteristics; the facility and its effluents; the impacts from construction and operation of the facility; alternatives to the proposed action; irreversible and irretrievable long-term commitments of resources from plant operation; need for power; and the benefits-cost analysis of the proposed plant operation. (FS)

26749 (DOCKET-50452-5) GREENWOOD ENERGY CENTER, UNITS 2 AND 3. Applicant's Environmental Report, Construction Permit Stage, Volume 2. (Detroit Edison Co., Mich.). 12 Sep 1973. 508p. (DOCKET-50453-5). Dep. NTIS $27.50.

26750 (DOCKET-50452-6) GREENWOOD ENERGY CENTER, UNITS 2 AND 3. Applicant's Environmental Report, Construction Permit Stage, Volume 3. (Detroit Edison Co., Mich.). 12 Sep 1973. 388p. (DOCKET-50453-6). Dep. NTIS $21.50.

26751 (DOCKET-50452-7) GREENWOOD ENERGY CENTER, UNITS 2 AND 3. License Application, PSAR, Volume 1. (Detroit Edison Co., Mich.). 20 Jul 1973. 547p. (DOCKET-50453-7). Dep. NTIS $29.50.

The general description of the plant, identification of the agents and contractors, and site characteristics including geography and demography; nearby industrial, transportation, and military facilities; meteorology; hydrologic engineering; geology; and seismology are presented for the plant which is to be located 15 miles northwest of Port Huron and about 10 miles west of Lake Huron. The design NSSS power level is 3600 MW(t) with an expected design net plant output of 1220 MW(e). (FS)

26752 (DOCKET-50452-8) GREENWOOD ENERGY CENTER, UNITS 2 AND 3. License Application, PSAR, Volume 2. (Detroit Edison Co., Mich.). 20 Jul 1973. 1073p. (DOCKET-50453-8). Dep. NTIS $52.00.

Appendices to the site characteristics concerning subsurface and foundations, report of boring records and laboratory testing, seismic refractions and elastic moduli measurements, boring logs, offsite wind and stability summaries, monthly meteorology summaries, and on site wind and stability summaries are presented. (FS)

26753 (DOCKET-50452-9) GREENWOOD ENERGY CENTER, UNITS 2 AND 3. License Application, PSAR, Volume 3. (Detroit Edison Co., Mich.). 20 Jul 1973. 635p. (DOCKET-50453-9). Dep. NTIS $34.00.

Design criteria including conformance with AEC general design criteria; classification of structures, components, and systems; wind and tornado loading; water level (flood) design; missile protection; protection against postulated pipe rupture; seismic design; design of category 1 structures; mechanical systems and components; seismic design of category 1 instruments and electrical equipment; and environmental design of mechanical and electrical equipment are presented. The mechanical, nuclear, thermal and hydraulic designs of the reactor are explained. (FS)

26754 (DOCKET-50452-10) GREENWOOD ENERGY CENTER, UNITS 2 AND 3. License Application, PSAR, Volume 4. (Detroit Edison Co., Mich.). 20 Jul 1973. 446p. (DOCKET-50453-10). Dep. NTIS $24.50.

The design of the reactor coolant system and connected systems including the reactor vessel, once-through steam generators, shaft-sealed reactor coolant pumps, an electrically heated pressurizer, and interconnecting piping all located entirely within the containment and the engineered safety features which include systems and components designed to function under design basis accidents to prevent or minimize the severity and mitigate the consequence of the accident are described. (FS)

26755 (DOCKET-50452-11) GREENWOOD ENERGY CENTER, UNITS 2 AND 3. License Application, PSAR, Volume 5. (Detroit Edison Co., Mich.). 20 Jul 1973. 665p. (DOCKET-50453-11). Dep. NTIS $35.25.

Designs for instrumentation and control systems including the reactor trip systems, engineered safety systems, systems required for safe shutdown, safety related display instrumentation, all other systems required for safety, control systems not required for safety, and other instrumentation systems are described. Onsite and offsite electric power and auxiliary systems, such as fuel storage and handling, water systems, process auxiliaries, air conditioning, cooling, heating, and ventilation, are presented. (FS)

26756 (DOCKET-50452-12) GREENWOOD ENERGY CENTER, UNITS 2 AND 3. License Application, PSAR, Volume 6. (Detroit Edison Co., Mich.). 20 Jul 1973. 419p. (DOCKET-50453-12). Dep. NTIS $23.00.

The turbogenerator and main steam supply system for steam and power conversion; radioactive waste management including liquid, gaseous, and solid wastes, tritium and the offsite radiological monitoring program; shielding, ventilation and the health physics program concerning radiation protection; conduct of operations including applicant's organization, training, emergency planning, review and audit, plant procedures and records, and industrial security; and the test program and staff for initial tests and operation are described. (FS)

26757 (DOCKET-50452-13) GREENWOOD ENERGY CENTER, UNITS 2 AND 3. License Application, PSAR, Volume 7. (Detroit Edison Co., Mich.). 20 Jul 1973. 464p. (DOCKET-50453-13). Dep. NTIS $25.25.

Accident analysis, technical specifications, and quality assurance during design and construction are presented. (FS)

26758 (DOCKET-STN-50437-9) OFFSHORE POWER SYSTEMS. Environmental Report, Supplement to Manufacturing License Application, Part II Appendices, June 1973. (Offshore Power Systems, Jacksonville, Fla. (USA)). 30 Aug 1973. 418p. Dep. NTIS $23.00.

Environmental effects of offshore reactor sites located off New Jersey, North Carolina, Florida, and Texas are presented. (FS)

26759 (DOCKET-STN-50437-10) OFFSHORE POWER SYSTEMS. Environmental Report, Supplement to Manufacturing License Application, Part II, June 1973. (Offshore Power Systems, Jacksonville, Fla. (USA)). Jun 1973. 468p. Dep. NTIS $25.50.

Environmental considerations relating to offshore siting of nuclear power plants and an evaluation of the concept from the point of view of overall environmental impact are presented. The environmental effects of construction and operation of a floating nuclear plant are examined. The descriptions include: the environment in the area, including the history, geography, geology, hydrology, climatology, ecology, land and water use including chemical characteristics; the facility and its effluents; the impacts from construction and operation of the facility; alternatives to the proposed action; irreversible and irretrievable long-term commitments of resources from plant operation; need for power; and the benefits–cost analysis of the proposed plant operation. (FS)

26760 (FIND-50259-R2) FIND: BROWNS FERRY NUCLEAR STATION, UNITS 1, 2, AND 3. Raleigh, H. D. (ed.). (Technical Information Center (AEC), Oak Ridge, Tenn.). Sep 1973. 36p. Dep. NTIS $4.00.

An index to microfiche issuances of safety analysis reports is provided. Subject citations are to specific frames on the microfiche. (JWR)

26761 (FIND-50315) FIND: DONALD C. COOK NUCLEAR PLANT, UNITS 1 AND 2. Raleigh, H. D. (ed.) (Technical Information Center (AEC), Oak Ridge, Tenn.). Aug 1973. 40p. Dep. NTIS $4.00.

An index to microfiche issuances of safety analysis reports is provided. Subject citations are to specific frames on the microfiche. (JWR)

26762 (RAI-73-8) REGULATORY ADJUDICATION ISSUANCES, AUGUST 1973. (Technical Information Center (AEC), Oak Ridge, Tenn.). 15 Sep 1973. 56p. Dep. NTIS $1.25 ea.

Issuances received from the U. S. Atomic Energy Commission, the Atomic Safety and Licensing Appeal Boards, and the Atomic Safety and Licensing Boards are presented. (JWR)

26763 (RAL-73-INDEX-1) INDEXES TO REGULATORY ADJUDICATION ISSUANCES, JANUARY–JUNE 1973. (Technical Information Center (AEC), Oak Ridge, Tenn.). 15 Sep 1973. 94p.

Issuances of the Atomic Energy Commission and the Atomic Safety and Licensing Boards are indexed in the following formats: case name index, digests and headers, legal citation index, subject index, and facility index. (JWR)

26764 (TID-26300-S1) INDEXES TO ISSUANCES OF THE ATOMIC ENERGY COMMISSION AND THE ATOMIC SAFETY AND LICENSING BOARDS, JULY–DECEMBER 1972. (Technical Information Center (AEC), Oak Ridge, Tenn.). Sep 1973. 44p. Dep. NTIS $4.00.

Issuances of the Atomic Energy Commission and the Atomic Safety and Licensing Boards are indexed in the following formats: case name index, digests and headers, legal citation index, subject index, and facility index. (JWR)

26765 LICENSING PROCEDURE FOR NUCLEAR POWER PLANTS. Foeyn, T. (Norges Vassdrags- og Elektrisitetsvesen, Oslo). Fossekallen; 20: No. 3, 9-10(Jun 1973). (In Norwegian).

In Norway, as in Sweden, the building and operating license for nuclear power plants is subject to a royal concession, which, in Norway, according to the Law on Atomic Energy Activities of 1972, may not be granted without the Storting's (Parliament's) agreement. The concession applies to a given site and, before being granted a concession, the applicant must present complete plans including safety evaluation. Other laws require that gaseous and liquid effluents be approved by appropriate bodies and a building permit be obtained from the building council. Such approval and permit require that opinions are obtained from a number of public bodies and private interests. In addition approval by various government departments is necessary. The law of 1972 established an Atomic Energy Inspectorate which is an advisory organ for the

Dept. for Industry in concession cases. An application for a concession will be sufficiently detailed to allow all instances to make their pronouncement. In the first instance the approval of the site is required, thereafter the reactor type and contractor. The final plans and safety report will then be presented to the Inspectorate who will advise the Dept. for Industry. The concession may then be granted and construction begun. Permission to begin operation must be granted by the Inspectorate. Provisionally it is anticipated that the first concession will be applied for early in 1974 and granted in 1976 or 1977. (NO)

GENERAL

Civilian Defense

26766 (AD-829366) CITY OF SAN JOSE, CALIFORNIA, VULNERABILITY OF GAS UTILITIES TO NUCLEAR ATTACK. Final Report. Davis, E. W.; Richford, M. A. (Office of Oil and Gas, Washington, D.C. (USA)). Aug 1967. 91p. NTIS.

The effects resulting from a hypothetical nuclear attack on the facilities and operating capability of the gas system supplying San Jose, California are examined. Normal operation of the system is described, and a functional inventory of buildings, transportation, communication, and other support equipment is provided. (auth)

Energy Utilization and Economics

Refer also to abstracts 26686 and 26953.

26767 (AD-760202) CLEAN AND ATTRACTIVE URBAN POWER SYSTEMS. Yen, J. T. (Grumman Aerospace Corp., Bethpage, N. Y. Research Dept.). Aug 1972. 37p. (RE-439-J). NTIS.

Various difficulties, such as siting and waste problems, facing the power industry at the present time are examined. It is proposed that these problems be resolved by integrating clean power plants into community centers. This can be done in such a way that not only power but also year-round recreation and job-training will be enjoyed and used by the residents. More specifically, the result is a new type of integrated system that is comprised of total-energy gas turbine power plants to be located in underground sites within the community centers and year-round recreation, job-training, and other facilities to be designed to suit local needs and to be located within the same community centers. It can be anticipated that such integrated systems will be attractive to and welcomed by the residents. (auth)

26768 (BNL-50384) WARM WATTS AND COOL CURRENTS: POWER TRANSMISSION BY SUPERCONDUCTING CABLE. Brookhaven Lecture Series Number 114. Forsyth, E. B. (Brookhaven National Lab., Upton, N. Y.). 25 Oct 1972. Contract AT(30-1)-16. 18p. Dep. NTIS $4.00.

The need to build very large machines at BNL, such as the AGS, has developed a strong capability in the field of power engineering. In addition, a strenuous effort has been made since the early sixties to develop practical superconducting magnets for accelerator applications. Thus it was natural to combine these areas of expertise when the Laboratory was requested to perform a study of power transmission by superconducting cable. During the course of this study a careful examination was made of all technologies proposed as solutions to the problem of transmitting very large blocks of electricity one to two decades hence, particularly if overhead lines are prohibited in urban areas. It was concluded that superconducting cables offered some potentially attractive features, although many serious technical problems had to be solved. A development program is in progress which includes the investigation of many of these problems, particularly in the areas of cryogenic engineering and materials suitable for carrying heavy currents and high voltages at very low temperatures. (auth)

26769 (CONF-720480-P1-R2) SYMPOSIUM ON ENERGY, RESOURCES, AND THE ENVIRONMENT. Session on International Issues. (MITRE Corp., McLean, Va. (USA)). 12 Apr 1972. 228p. (M-72-69(Vol. 1)(Rev. 2)).

This report provides a transcript of the proceedings on the first day, April 12, 1972, of the symposium. Mr. Charles A. Zraket, Senior Vice President, The MITRE Corporation, opened the session with a summary of the overriding issues identified and the conclusions drawn during the five preparatory meetings for the Symposium. Mr. Robert B. Panero, Director of Economic Development Studies for Hudson Institute, presented a context for the session. Dr. Jay Forrester, Professor at the Massachusetts Institute of Technology discussed the results of his computer simulation of world dynamics and the implications for policy decisions. Dr. Herman Kahn, Director, Hudson Institute, presented an economic basis for energy and resource use to solve international societal problems in the future. Dr. Glenn Werth, Associate Director for Plowshare, Lawrence Livermore Laboratory, gave a review of world-wide energy demand and resources and technology for meeting that demand. Dr. Robert A. Charpie, President, Cabot Corporation, described the venture his company is making in importing liquefied natural gas from Algeria. The session closed with a question and answer period with all the speakers participating as a panel. (auth)

26770 (CONF-720480-P2-R1) SYMPOSIUM ON ENERGY, RESOURCES, AND THE ENVIRONMENT. Session on Ethics and Environmental Aspects of the Demand for the Use of Energy. (MITRE Corp., McLean, Va. (USA)). 13 Apr 1972. 252p. (M-72-69(Vol. 2)(Rev. 1)).

A transcript is provided of the proceedings on the second day, April 13, 1972, of the symposium. Dr. S. Fred Singer, Professor at the University of Virginia and formerly Deputy Assistant Secretary of the Interior, discussed national energy policy in terms of providing abundant, low-cost, clean energy. Dr. Marvin R. Gustavson, of the Lawrence Livermore Laboratory presented the need for development of a "consensual energy ethic." Mr. S. David Freeman of the Twentieth Century Fund, and formerly Director of the Energy Policy Staff in the Office of Science and Technology, discussed the issues involved in developing our energy and environmental ethic. Mr. John F. O'Leary, formerly Director, U. S. Bureau of Mines, presented a comprehensive set of energy, resource, and environmental issues and described some changes to governmental institutions for dealing with the energy crisis. Dr. Marc Roberts, Professor at Harvard University, explored three mechanisms for achieving cleaner power: prices, regulation, or direct public provision. Dr. Greeley, Associate Technical Director of the MITRE Corp., presented some environmental issues which had been raised in the previous meetings. The session closed with a question and answer period with all the speakers participating as a panel. (auth)

26771 (CONF-720480-P3-R1) SYMPOSIUM ON ENERGY, RESOURCES, AND THE ENVIRONMENT. Session on Options for the Future and Their Resources, Economic, and Environmental Effects. (MITRE Corp., McLean, Va. (USA)). 14 Apr 1972. 198p. (M-72-69(Vol. 3)(Rev. 1)).

A transcript is provided of the proceedings on the third day, April 14, 1972, of the symposium. Monsieur Jean DeGroote, Director of Economic Research at Hydro-Quebec, opened the session and introduced the keynote speaker, Dr. Clarence E. Larson, Commissioner, U. S. Atomic Energy Commission. He presented a comprehensive set of technological developments which provide a wide range of options for the future. Dr. Masao Sakisaka, President of the Institute of Energy Economics of Japan, described the energy, resources, and environmental situation in Japan. Dr. William W. Kellogg, Director of the Laboratory of Atmospheric Sciences, National Center for Atmospheric Research discussed the impact of man's energy use on world climate. Mr. Lelan F. Sillin, Jr., President of Northeast Utilities and Member of the Citizens' Advisory Committee on Environmental Quality, spoke about some of his ideas for a major R&D program to meet the energy crisis. Mr. Keith Roberts, Consultant to the Sierra Club, presented the views of an environmentalist. Dr. Richard E. Balzhiser, Assistant Director for Natural Resources, Office of Science and Technology, discussed energy options that the Federal government is or should be pursuing. The session closed with a question and answer period with all the speakers participating as a panel. (auth)

26772 (CONF-721112-10) SUBSTITUTE NATURAL GAS FROM ORGANIC MATERIALS. Schneider, T. R. (Pennsylvania Univ., Philadelphia (USA). National Center for Energy Management and Power). 1972. 34p.

From American Society of Mechanical Engineers winter meeting; New York, New York, USA (26 Nov 1972).

The process of converting organic materials to methane via anaerobic fermentation appears to be both technically and economically feasible for large-scale use in converting the organic component of solid waste, both municipal and agricultural, to methane. Methane is an easily transported fuel and the major component of natural gas. The conversion of solar energy to plant material through photosynthesis and the conversion of organic plant material to methane is discussed. The growth of an energy crop as a feedstock for the manufacture of methane rests on development of a highly productive and inexpensive crop. Since photosynthesis and crop growth is not a very efficient energy conversion system, large areas would be required to fill a significant portion of the current gas demand. A theoretical upper bound on the efficiency of the conversion of solar energy into chemical energy in the form of plant material of 11% is obtained. Losses resulting from other aspects of plant biology reduces this efficiency to 5% to 6% in practice. Record daily plant growth rates confirm this figure. Factors which limit annual crop yields to levels below the value of the projected daily yields are evaluated. The above figures define the conversion efficiency of sunlight reaching the plant; efficiencies based on monochromatic light of optimal wavelength can yield higher efficiencies, but their use with respect to the problem under consideration is inappropriate. (auth)

26773 (CONF-721224-1) RECOMMENDATIONS PRESENTED TO ATOMIC ENERGY CONTROL BOARD BY WORK GROUP MEETING IN LIMA FROM 17–22 DECEMBER 1972. (Junta de Control de Energia Atomica, Lima (Peru)). 1972. 24p. Dep. NTIS $3.25.

From Atomic Energy Control meeting; Lima, Peru (17 Dec 1972).

Peru will use nuclear electric power within the context of an accelerated development process. This fact requires a significant technological scientific effort in the nuclear field. The IPEN (Instituto Peruano de Energia Nuclear) is demonstrating a favorable attitude with respect to a rational approach to the process. It is believed that the very process will have a promotional effect, making possible the parallel development of other areas of application of nuclear energy, especially those of immediate socio-economic benefit. Within this context, the objectives, programs, and action considered to be most suitable for the future development of the nuclear energy program in Peru are indicated, taking into account the benefit–cost relationship. (auth)

26774 (CONF-730904-4) ROLE OF ENERGY IN AGRO-INDUSTRIAL DEVELOPMENT. Hammond, R. P. (Oak Ridge National Lab., Tenn.). [nd]. 6p. Dep. NTIS $3.00.

From fourth international symposium on fresh water from the sea; Heidelberg, F. R. Germany (9 Sep 1973).

Experience has shown that both agricultural and industrial sectors of any region must be developed together, and that both are dependent on access to cheap energy, which plays a key role. An agro-industrial complex is an efficient way to provide a balanced input of energy and technology. Such a complex, and the more general concept of an energy center, gains efficiency in capital cost, fuel cost, land use, transport, raw material consumption, and in the use of human resources. The inherently large size of a complex is a disadvantage, but there are several ways in which this problem can be minimized. (auth)

26775 (NP-19772) WORLD ENERGY SUPPLY/DEMAND DURING A PERIOD OF CRISIS. (Interdevelopment, Inc., Arlington, Va. (USA)). Dec 1972. 190p. Interdevelopment, Inc., Arlington, Va. (USA).

In 1968 oil contributed 40%, coal 38%, gas 20%, and other sources (mainly hydroelectric) 2% to the total world-energy consumption of approximately 165,000-trillion Btu. Coal lost its lead in about 1960. The present world-energy situation will probably lead to significantly higher energy prices and pressure to reduce energy consumption. Coal represents the largest available potential source of energy from fossil fuels in the world, but the geographical distribution often does not match the location of areas of high consumption. Moreover, increasingly stringent air-pollution control regulations preclude the use of much of the coal with a high sulfur content until commercially economic processes to remove sulfur-dioxide from stack gases or to gasify coal become available. At current production rates proved world reserves of oil and gas would last some 30 to 40 years, and production is increasing rapidly. Although actual reserves are undoubtedly considerably greater, the locations will probably involve appreciably higher exploration and production costs than in the past. Oil shale and tar sands represent a significant potential source of oil. In spite of high conversion costs, these reserves will become commercially interesting as other supplies dwindle. Even without breeding, world uranium supplies seem adequate to supply demand without a large increase in price for many years. If present projections of installed nuclear capacity are correct, additional enrichment capability will be required in the early 1980's. The international trade in fuels, already quite large, will undoubtedly expand greatly in the coming years, and a significant increase in tanker capacity will be required. (auth)

26776 (NP-19773) TECHNO-ECONOMIC SURVEY OF TRENDS IN THE U. S. ELECTRIC-POWER INDUSTRY AT A TIME OF TRANSITION. Part II. Report on Investigations. (Interdevelopment, Inc., Arlington, Va. (USA)). Sep 1972. 215p. Interdevelopment, Inc., Arlington, Va. (USA).

An overall view is provided of the probable directions in the demand, production, transmission, and distribution of electric power in the U. S. Detailed information is included on: U. S. requirements and generating capacity; the structure of the U. S. electric power industry; factors acting to produce changes, such as economics, environmental considerations, fuel supply, and technological trends; fuels; research and development work on power systems; power generation systems and equipment; power plants and supply networks; transmission and distribution; and economics. (LCL)

26777 (NP-19775) TECHNO-ECONOMIC SURVEY OF TRENDS IN THE U. S. ELECTRIC-POWER INDUSTRY AT A TIME OF TRANSITION. Part I. Summary and Conclusions. (Interdevelopment, Inc., Arlington, Va. (USA)). Sep 1972. 23p. Interdevelopment, Inc., Arlington, Va. (USA).

The results and conclusions of a 1971–1972 techno-economic survey of trends in the U. S. electric power industry are presented. These conclusions relate to power generating capacity, the effects of environmental considerations on the construction and operation of new generating plants, fuel economics involving coal, oil, natural gas, and nuclear fuels, required research and development programs, the development of larger capacity generating and transmission systems, the need for a national energy policy, and the effect of the increasing time lag between the ordering and operation of new generating facilities. It is concluded that due to the complicated forces acting, it is not possible to predict now whether supply can meet projected demand over the next decade or so. (LCL)

26778 (NP-19784) INFLUENCE OF AZIMUTHAL ORIENTATION ON COLLECTIBLE ENERGY IN VERTICAL SOLAR COLLECTOR BUILDING WALLS. Lorsch, H. G.; Niyogi, B. (Pennsylvania Univ., Philadelphia (USA). National Center for Energy Management and Power). Aug 1971. 22p.

The requirement of southern exposure for the collector seriously constrains the architectural freedom of planning and designing solar-heated buildings. Work was performed to determine the reduction in available energy from vertical solar collectors that do not face due south. For median US latitude and the critical winter months of December and January, it was found that a 23° deviation from the exact southern orientation produces only a 5% energy penalty, a 33° deviation a 10% penalty. Detailed graphs are presented showing energy penalties as a function of calendar month, azimuth, and latitude. (auth)

26779 (NP-19786) PLEXIGLAS DR THERMAL STABILITY TEST. Saunders, A. P. (Pennsylvania Univ., Philadelphia (USA). National Center for Energy Management and Power). 14 Aug 1972. 5p.

In order to assess the deformation behaviour of Plexiglas DR, an uncooled 2 × 4-ft solar collector with an inner pane of 0.030 in.-thick Plexiglas DR, and outer pane of double-strength Lustraglass, and an aluminum absorber plate painted matte black, was exposed to the sun on two successive days. The test showed that Plexiglas DR (a Rohm and Haas extrudable methyl methacrylate) used as the inner sheet in a nonoperating double-pane solar collector exposed to summer solar radiation suffers major distortions. This material is not suitable for use in this environment unless the collectors are shielded from the sun during collector shutdown. (auth)

26780 (NP–19787) PROGRAM PLAN FOR THE NATIONAL CENTER FOR ENERGY MANAGEMENT AND POWER. Denton, J. C. (Pennsylvania Univ., Philadelphia (USA). National Center for Energy Management and Power). 15 Jan 1973. 65p.

The task of the National Center for Energy Management and Power, established in May 1971, is to educate "problem-solving" individuals who can successfully manage the Nation's energy and power problems to enable the society to pursue its objectives. The planning of educational and research programs at the Center for achieving this goal in close cooperation with industry and the government is discussed. (LCL)

26781 (NP–19788) STATUS REPORT, MAY 1972. (Pennsylvania Univ., Philadelphia (USA). National Center for Energy Management and Power). 1972. 60p.

The National Center for Energy Management and Power at the University of Pennsylvania was created in May 1971. During this first year of operation much of the Center's resources were spent to establish the program, assemble a faculty that has a strong interest in the area of energy and power management, and provide a basis of understanding so that both faculty and students in the Center may interact. Considerable time was devoted to making the Graduate Group Committee of Energy Management and Power operational. Much effort was required to bring about a different kind of educational program than has existed at the University of Pennsylvania before. The major portion of the Center's resources in the future will be devoted to research activities including interdisciplinary research in ways of increasing the energy supply, methods for modifying energy demand, and means of adjusting the quantitative relations between supply and demand, and small disciplinary research projects. (auth)

26782 (NP-19822) ENERGY, RESOURCES, AND THE ENVIRONMENT. Zraket, C. A. (MITRE Corp., McLean, Va. (USA)). Dec 1972. 39p. (M-72-180(Rev. 3)).

A substantive summary is presented of eight symposia held during the period July 1971 to July 1972 on the interrelationships of energy, resources, and the environment. Topics discussed include: the growth issue as it affects the long-term situation; future outlook for energy and resources; the international aspects of energy-resources-environment interrelationships; the energy crisis in

the near future; options for the long term; transportation; and current and long-term problems. (LCL)

26783 (NP-19838) ENERGY SITUATION AND NUCLEAR POWER. Holy, Z. J. (New South Wales Univ., Kensington (Australia). School of Nuclear Engineering). 1973. 29p. Dep. NTIS (U. S. Sales Only) $3.50.

A survey of the characteristics and potential applications of nuclear reactors for electricity and process heat production is presented, against a background of increasing global energy demand, fossil and nuclear-fuel reserves, and environmental problems of power production. The large-scale adoption of nuclear power using breeder reactor systems appears inevitable in the long term, but complex and rapidly changing interaction between local and global factors makes projections for any specific country increasingly difficult. (auth)

26784 (ORNL-EIS-73-52(Vol.1)(No.9)) NSF-RANN ENERGY ABSTRACTS. A Monthly Abstract Journal of Energy Research. Guthrie, M. P. (ed.) (Oak Ridge National Lab., Tenn.). Sep 1973. Contract W-7405-eng-26. 24p. Dep. NTIS $3.25.

One-hundred abstracts are presented of recently published articles on: energy resources; energy conversion: energy production, consumption, economics, and policy; electric power production, consumption, and transmission; and environmental studies related to power production and use. Each abstract is accompanied by the following information: title; author; corporate author with address; publication description; publication date; research sponsor; and availability. (LCL)

26785 (ORNL-HUD-MIUS-9) MIUS TECHNOLOGY EVALUATION: SOLID WASTE COLLECTION AND DISPOSAL, AUGUST 1973. Boegly, W. J. Jr.; Haynes, V. O.; Hise, E. C.; Compere, A. L.; Griffith, W. L. (Oak Ridge National Lab., Tenn.). Sep 1973. Contract W-7405-eng-26. 87p. Dep. NTIS $5.45.

Solid waste collection and disposal may be performed within the Modular Integrated Utility Systems (MIUS), which will serve from 100 to 3000 dwelling units. Current and future technology are evaluated for MIUS use. Depending on the size and the types of buildings in the MIUS, it may be practical to make use of innovations in solid waste collection using commercially available equipment. Individual home compaction units, apartment house compactors or bailers, and vacuum, slurry, or pneumatic collection systems might be applied to reduce the cost of collection and improve the environmental impact of solid waste collection practices. However, the costs of vacuum collection systems currently appear to be reasonable only in very highly populated areas, such as those occupied by medium- and high-rise buildings. Changes in the form of the collected material may affect the disposal operation. For example, if wastes were bailed at each apartment building, it might not be necessary to provide expensive compaction equipment at a sanitary landfill site. Conversely, if wastes were to be burned for heat recovery, a vacuum collection system might be more desirable to provide the fuel for the incineration in a more constant fashion and eliminate storage facilities at the incinerator. Many methods for solid waste disposal look promising, but the economics and operating problems are not well understood in the size ranges for use in a MIUS. Sanitary landfill could be used, but heat recovery from incineration would be more in keeping with MIUS objectives. Data indicate that the economics of employing incineration with heat recovery might be acceptable. However, very little equipment development work has been done in systems in the range of small sizes suitable for the MIUS, and there is little field operating experience. Additional equipment cost data and analyses of specific housing complexes are required to obtain definitive economic evaluations. Because of the size of the MIUS, resource recovery from the incinerator residue from an individual MIUS does not appear promising because of the equipment required and the relatively small amount of recoverable material available. If there were enough MIUSs in one area, it might be possible to construct a central recovery plant at a later date when sufficient material is available. It is concluded that sufficient innovative technology is available at this time to consider its application to solid waste collection and disposal in near-term MIUS designs. (10 figures, 21 tables, 90 references) (auth)

26786 (ORNL-TM-4305) PROSPECTS FOR HYDROGEN AS A FUEL FOR TRANSPORTATION SYSTEMS AND FOR ELECTRICAL POWER GENERATION. Escher, W. J. D. (Oak Ridge National Lab., Tenn.). Sep 1973. Contract W-7405-eng-26. 56p. Dep. NTIS $5.00.

The potential application of hydrogen, produced from non-fossil domestic sources, is examined for applicability to the transportation and electrical generation sectors. The characteristics of hydrogen as a gas and as a cryogenic liquid are noted; cost trends are presented. Ground, water, and air transportation modes and systems are individually examined with respect to a potential conversion to hydrogen fuel. Electrical generation systems, both conventional and unconventional, are assessed similarly. Hydrogen's potential for transmission and storage of electrical energy is cited. From these findings, a detailed list of recommended study, research and development, and demonstration system topics is given toward implementing an eventual conversion of transportation and the electrical utilities to hydrogen fuel. (auth)

26787 (ORNL-TM-4307) STORAGE AND TRANSPORTATION OF SYNTHETIC FUELS. A Report to the Synthetic Fuels Panel. Johnson, J. E. (Oak Ridge National Lab., Tenn.). Sep 1972. Contract W-7405-eng-26. 20p. Dep. NTIS $3.00.

This report summarizes various contributions by the technical staff of the Engineering and Research Departments of the Linde Division of Union Carbide Corporation. It includes a review of the problems associated with the storage and transportation of energy by the major candidate synthetic fuel systems—hydrogen and hydrogen-derived fuels, such as ammonia and methanol. Particular emphasis has been placed on the identification of limiting technologies and on areas in which research and development efforts should be undertaken to contribute solutions to the nation's growing problems of energy resources, transmission and conversion. (auth)

26788 ASSESSMENT OF FLUIDIZED-BED OIL GASIFICATION FOR POWER GENERATION. Newby, R. A.; Keairns, D. L.; Archer, D. H. (Westinghouse Research Corp., Pittsburgh). J. Air Pollut. Contr. Ass.; 23: No. 1, 23-29(Jan 1973).

Fluidized-bed gasification of high-sulfur oil at atmospheric pressure for the production of a clean fuel gas was evaluated technically and economically. The clean fuel gas with minimal sulfur and particulates is utilized for power generation in conventional fossil-fuel-fired boilers. The gasification occurs in a limestone bed. Hydrogen sulfide produced during the cracking and partial combustion of the oil is removed by the lime to yield a clean fuel gas and sulfided lime. The hot, low-sulfur, low-Btu fuel gas is burned in a steam generator. The process can be operated as a once-through, throwaway limestone system or as a limestone regeneration/sulfur recovery system. The sulfided lime can be converted to calcium sulfate in an air-fluidized vessel, operating near 1500°F, for dry disposal in the once-through concept. The regeneration system converts the sulfur in the stone to SO_2 in an air-fluidized bed operating near 1900°F. The regenerated stone is circulated back to the gasifier and the SO_2-rich stream (~10 mole %) goes to a sulfur or sulfuric acid recovery system. The technical feasibility of the concept was demonstrated. Sulfur removal up to 95% was achieved. Specifications and design concepts are developed for retrofit on existing utility boilers and for new plants based on experimental data. Conceptual designs, performance, and costs for retrofit systems show that the concept offers an economic method for achieving SO_2, NO_x, and particulate emission regulations. Capital cost of a retrofit, once-through gasification system is estimated to be 50 to 70% less than a retrofit wet-scrubbing system. Combined capital and operating costs for the gasification process may be 30 to 50% less in intermediate-load plants than such alternatives as wet scrubbing or the use of low-sulfur oil products. Plant reliability may be increased with the gasification system due to reduction in SO_3, vanadium, and sodium before the boiler. A demonstration installation of an add-on oil gasification unit on an existing utility boiler is recommended. (5 figures, 8 tables) (auth)

26789 ALTERNATIVES: R AND D FOR NEW ENERGY SOURCES. Econ. Priorities Rep.; 3: No. 2, 23-25(May 1972).

As a result of the advent of nuclear power, utilities have come to growing reliance on federal government for long-range R and D. Of 0.23% of gross revenues that industry does spend on R and D, most is used for improving present systems and not on developing new, minimally polluting ones. Reviewed are economic, environmental, and political aspects of the nuclear breeder reactor (which gets lion's share of attention), proposed fusion reactor, solar energy (totally ignored by utilities and government), geothermal steam, tidal energy, wind generation, direct conversion (MHD and fuel cells), recycling waste heat, coal gasification, and establishing of national power grid. (NSIC)

26790 FUTURE OF THE STEAM-POWERED ELECTRICITY WORKS IN FRANCE. Weber, P. (Electricite de France, Chatou). Ingenieursblad; 42: No. 6, 141-143(1973). (In French).

Described are conventional, or fossil fuel-fired steam power plants for electric power production in France which are to be progressively replaced by nuclear power plants. Low-output steam power plants which, due to low investment cost, may be appropriate to operate for supplementing the nuclear power plants from 1980 onwards are also discussed. (auth)

26791 IEEE CONFERENCE ON RESEARCH FOR THE ELECTRIC POWER INDUSTRY. Conference Held at Washington, DC, December 11-14, 1972. New York; Institute of Electrical and

Electronics Engineers, Inc. (1973). 471p. (CONF-721210-). $20.00.

Fifty-nine presentations and various discussions are included on research needs in engineering, scientific, and social subjects pertinent to the electric power industry. They are arranged into sessions dealing with possible impact of research; organization, funding, and administration; nuclear energy; fossil energy; embryonic energy conversion methods; overhead transmission systems; underground transmission systems; systems planning, control, and security; and environmental betterment. (DLC)

26792 WHAT ARE THE REAL COSTS AND BENEFITS OF PRODUCING "CLEAN" ELECTRIC POWER? Alexander, M. O.; Livingstone, J. L. Pub. Util. Fortn.; 92: No. 5, 15-19(30 Aug 1973).

An example of a systematic method of analysis for a pollution cost/benefit study is given, dealing with a leading electric utility in a major city. Although it was applied only to a single company, the same method can be used for any company. In the example, the benefits of pollution abatement substantially outweighed the costs to the public. This method provides information that does not appear in conventional accounting systems. It supplies facts for making a case to the public, government, and regulatory agencies that utilities are not out to thwart pollution control standards or to extort higher prices from a resentful public, and thus provides a basis for positive public statements on the "real" cost of electric power. (DLC)

26793 IS AN ENERGY CRISIS INEVITABLE? Cook, D. C. Pub. Util. Fortn.; 92: No. 4, 17-22(16 Aug 1973).

An electric energy crisis will probably result if the federal government does not modify deadlines for compliance with secondary air quality standards, but it will be short-lived. The energy outlook and the forms of energy available are discussed. The promise of nuclear power plants is shown to be far from bright, while the use of our large coal resources is hampered by the air quality standards. The need for a national energy policy and for common sense in reconciling the standards with the need for electric power is pointed out. There is no reliable, commercially available technology for SO_2 removal from stack gases. (DLC)

26794 THYRISTOR VALVE GOES ON TEST FOR NORWAY HVDC LINK. Jeffs, E. (ed.) Energy Int.; 10: No. 8, 25-26 (Aug 1973).

The prototype of a new generation of solid-state valves for hvdc converter stations has been installed in the Danish terminal of the Konti-Skan link as part of the test program associated with the proposed Norway–Denmark hvdc intertie. (auth)

26795 UNCONVENTIONAL SOURCES OF ENERGY FOR MILLIONS. Rao, V. A. (University Grants Commission, New Delhi). Sci. Cult. (Calcutta); 39: No. 4, 157-163(Apr 1973).

A study of the present rate of development of the conventional sources of energy in India in recent years indicated that coal, oil, and radioactive sources of energy will be exhausted by the end of the present century. In order to meet the increasing demand of energy for agricultural development and in order to solve the socio-economic and environmental-pollution problems, the necessity of the development of unconventional sources of energy—solar, wind, geothermal, and tidal—is stressed. (auth)

26796 GEOTHERMAL ENERGY IN MEXICO: EXPLORATION AND UTILIZATION. Guiza, J.; Mercado, S. (Comision Federal de Electricidad, Mexico City). pp 183-189 of III Interamerican Conference on Materials Technology. Buenos Aires; Centro Regional de Ayuda Tecnica (1972). (In Spanish).

From 3rd inter-American conference on materials technology; Rio de Janeiro, Brazil (14 Aug 1972). See CONF-720832-.

Geothermal heat is the "new" energy that has attracted the attention of Mexican scientists, technologists, and economists who have undertaken its harnessing. Mexico has two principal geothermal systems (north and central) with more than a hundred classified thermal centers. Under development is the Cerro Prieto field which plans on a plant of 75 MW being programmed for an immediate increase to 150 MW. Being explored are the following fields: Ixtlan, Los Negritos, San Marcos, La Primavera, Tulichec, etc. The principal use of such energy will be in the generation of electricity, with decreasing fossil-fuel consumption and less environmental pollution. 11 figures. (auth)

26797 FLUIDIZED-BED COAL COMBUSTION SYSTEM COUPLED TO A POTASSIUM VAPOR CYCLE (ENGINEERING MATERIALS). (Oak Ridge National Lab., Tenn.). (CAPE-2351). 2 drawings.

A schematic diagram of the system is given. Temperature measurements along the test section are shown. (MOW)

26798 GAS ENGINES: ECONOMIC USE OF PREMIUM FUEL. Dolan, J. Energy Int.; 10: No. 8, 19-21(Aug 1973).

The use of gas engines in the Queen Mary tourist center is pointed out. The advantages of gas engines (economy and cleanliness) are mentioned, and some of their possible applications are described. Some of the technical characteristics of the modern gas engine are surveyed, and its development history is traced. (DLC)

26799 COAL GASIFICATION: THE NEW ENERGY SOURCE. Williams, J. E.; Dressel, J. H. (Stearns-Roger, Inc., Denver). pp 47-52 of Mining Year Book, 1973. Denver; Colorado Mining Association (1973).

From National western mining conference and exhibition; Denver, Colorado, USA (8 Feb 1973). See Conf-730219-.

Coal gasification is a means for solving the energy–ecological crisis in the US. Information is presented on: what coal gasification is; gasification processes presently available; new processes under development; types of gasification projects being studied on a commercial scale; the size of the mine and coal preparation plant necessary to support a 250-MMSCFD gasification plant; and some of the difficulties encountered in materials handling for a commercial gasification plant. (LCL)

Information Handling

26800 (EUR-5023) BETTER SERVICE FOR THE USER. Proceedings of the EUSIDIC Conference, Luxembourg, October 18–19, 1972. (European Atomic Energy Community, Luxembourg. Center for Information and Documentation). Jun 1973. 213p. (CONF-7210106-). EUR BF 275.-.

The following are included: description of systems (in the field of chemistry, metallurgy, medicine, nuclear sciences); computer services; experience with SDI on tapes; on-line searching; network; needs to information users in industry and at universities. (EU)

26801 (IAEA-INIS-1(Rev.2)) INIS: DESCRIPTIVE CATALOGUING RULES. Del Bigio, G.; Gottschalk, C. M.; Ruckenbauer, E. (International Atomic Energy Agency, Vienna (Austria)). Jun 1972. 96p. INIS.

26802 (IAEA-INIS-3(Rev.3)) INIS: SUBJECT CATEGORIES AND SCOPE DESCRIPTIONS. (International Atomic Energy Agency, Vienna (Austria)). Dec 1972. 44p. INIS.

26803 (IAEA-INIS-4(Rev.1)) INIS: INSTRUCTIONS FOR SUBMITTING ABSTRACTS. (International Atomic Energy Agency, Vienna (Austria)). Aug 1971. 40p. INIS.

26804 (IAEA-INIS-5(Rev.2)) INIS: TERMINOLOGY AND CODES FOR COUNTRIES AND INTERNATIONAL ORGANIZATIONS. (International Atomic Energy Agency, Vienna (Austria)). Jul 1971. 13p. INIS.

26805 (IAEA-INIS-7(Rev.1)) INIS: MAGNETIC AND PUNCHED PAPER TAPE CODES AND CHARACTER SETS. (International Atomic Energy Agency, Vienna (Austria)). Feb 1971. 20p. INIS.

26806 (IAEA-INIS-8(Rev.1)) INIS: PAPER TAPE SPECIFICATIONS AND RECORD FORMAT. (International Atomic Energy Agency, Vienna (Austria)). Feb 1971. 25p. INIS.

26807 (IAEA-INIS-9(Rev.1)) INIS: MAGNETIC TAPE SPECIFICATIONS AND RECORD FORMAT. (International Atomic Energy Agency, Vienna (Austria)). Feb 1971. 26p. INIS.

26808 (IAEA-INIS-10(Rev.1)) INIS: TRANSLITERATION RULES FOR SELECTED NON-ROMAN CHARACTERS. (International Atomic Energy Agency, Vienna (Austria)). Mar 1971. 7p. INIS.

26809 (IAEA-INIS-12(Rev.1)) INIS: MANUAL FOR INDEXING. Todeschini, C. (International Atomic Energy Agency, Vienna (Austria)). Dec 1971. 70p. INIS.

26810 (IAEA-INIS-13(Rev.3)) INIS: THESAURUS. (International Atomic Energy Agency, Vienna (Austria)). Jan 1973. 518p. INIS.

26811 (IAEA-INIS-14(Rev.0)) INIS: DESCRIPTION OF COMPUTER PROGRAMS. Del Bigio, G.; Schmid, H. (International Atomic Energy Agency, Vienna (Austria)). Apr 1972. 232p. INIS.

26812 (IAEA-INIS-15(Rev.0)) SELF-TEACHING MANUAL FOR DESCRIPTIVE CATALOGUERS. (International Atomic Energy Agency, Vienna (Austria)). Sep 1972. 40p. INIS.

26813 (JAERI-M-4649) PROGRESS REPORT ON THE INIS OPERATIONS IN THE HEADQUARTERS AND THE JAERI FOR THE FIRST YEAR, 1 APRIL 1970–1 May 1971. (Japan Atomic Energy Research Inst., Tokyo). Dec 1971. 21p. (In Japanese). INIS.

Outlined are achievements, subject and bibliographic control, computer operations and distribution of output products in the Headquarters. Briefly reviewed are achievements, managements and improvements of techniques to input for INIS from the JAERI, national center for INIS in Japan too. Japanese Committee for INIS was set up on October 1970, to advise the President of the Institute on principal management in Japan for INIS. Cited are activities of the committee as well as difficulty related to compilation of the Japanese authority files described in English. Emphasized is the necessity for further cooperation with associated organizations, to develop effective utilization system of outputs in the country and to cope with expansion of inputs to be planned in the next step. (auth)

26814 AUTOMATIC TRICOLOR CARTOGRAPH: MARK I (ENGINEERING MATERIALS). (Chicago Operations Office (AEC), Ill.). (CAPE-2345).

45 drawings.

Improvements made on the Automatic Tricolor Cartograph–Mark I are described. The Cartograph is a self-contained system for performing the automatic coloring of operator-designated bounded areas on a color display. It has its own storage and refresh. In the original version, the storage of colored areas was such that striations were somewhat noticeable on the display. In addition, the only means of inputting outline information (to define the bounded regions) was by means of the light pen. Only saturated colors were possible. The improvements described here were developed to eliminate the above 3 shortcomings of the original system. A demodulation scheme was developed to eliminate the striations. An input system using a television camera was developed so that line drawings can be input directly without using the pen. Finally, a scheme for linear writing was developed so that the 3 primaries can be varied in saturation. See also COO-1469-0204. (auth)

Law

26815 NUCLEAR ENGINEERING: A SUBJECT FOR GERMAN-SOVIET CO-OPERATION. Morosow, I. VDI (Ver. Deut. Ing.) Nachr.; 27: No. 22, 18(1973). (In German).

Following up to present efforts made to obtain a technical scientific cooperation, a description is given of the background of the general development of nuclear energy. Furthermore, the exact terms of the undersigned German–Soviet trade agreement held on 19th May 1973 is given. (GE)

26816 LIABILITY FOR ENVIRONMENTAL DAMAGES. Diederichsen, U. Versicherungswirtschaft; 28: No. 15, 921-928(1973). (In German).

From conference on environmental protection: technique and liability; Goettingen, Ger. (29 Mar 1973).

The lecture generally concerns keeping the countryside, air, and waters clean and the liability for environmental damage and deals with environmental contamination, norms which establish the liability and obligations to indemnify, the polluter-pays principle, the liability laws, and the legal instrument of the so-called traffic insurance duties such as the planned law on protections against emissions of the FRG, and problems of the environmental public liability insurance. (GE)

Management

26817 (JUL-899-WT) PROPRIS: METHOD FOR STEPWISE PLANNING AND FOR CONTINUOUS REPRESENTATION OF THE PROGRESS OF RESEARCH AND DEVELOPMENT PROJECTS. Gehring, H.; Ruin, R.; Sassin, W.; Tappenhoelter, D. (Kernforschungsanlage, Juelich (West Germany). Wissenschaftlich-Technische Abt.). Nov 1972. 59p. (In German). Dep. NTIS (U. S. Sales Only) $5.00.

An attempt was made to clarify the application of some management information and control systems on the market for these purposes. It was shown that no information system corresponding to the practical requirements was available. This result led one to develop the most simple possible and under the circumstances practical installable process for planning and representation of the progress of research and development plans. The stepwise planning and the permanent adaption to the further running of the project, so far as can be seen, are new to the developed process "PROPRIS" (PROject Planning and Review Information System). In this planning in stages system, firstly the task groups are roughly planned and then fitted gradually into a detailed network scheme. In addition, the possibility of describing the dispositive status of the task groups and activities has been planned as well as the inclusion in the project file of further information which is not accounted for by the network process. The proposed process can be materialized and operated with a small financial expenditure. The cost of a medium size project with some 100 taking part, consisting of data acquisition costs, storage, data maintenance until required for information, is in the region of 120,000 DM per year. Also for smaller planning (about 20 people), the corresponding expenses merely increase by 20% per person. (GE)

26818 (JUL-930-FF) DECISION-THEORY ASPECTS OF PHYSICAL EXPERIMENTS. Hossfeld, F. (Kernforschungsanlage, Juelich (West Germany). Institut fuer Festkoerperforschung). Mar 1973. 67p. (In German). Dep. NTIS (U. S. Sales Only) $5.50.

The subject is reviewed, citing references from 1928 up through 1972. (1 table, 16 figures, 47 references) (LMT)

26819 (NP-19831) RESEARCH AND DEVELOPMENT FOR 1972. Scientific Report. (Kernforschungsanlage, Juelich (West Germany)). [nd]. 306p. (In German). Dep. NTIS (U. S. Sales Only) $17.50.

Research and development work is reported for 1972 for each institute and central installation of the KFA Juelich. Priorities, ongoing projects, infrastructure of the organization, cooperation with other research facilities, and results of work are given for each institute. More than 140 single projects are presented. (HBG)

26820 (NP-19834) SIXTEENTH ANNUAL REPORT, 1972. (Atomic Energy Board, Pelindaba, Pretoria (South Africa)). 1972. 62p. Dep. NTIS (U. S. Sales Only) $5.25.

The activities of the Atomic Energy Board of the Republic of South Africa during 1972 are briefly reported. The activities include research on nuclear materials, nuclear power, radiation and radioisotope uses, health and safety, waste disposal, and several other subjects. (JWR)

26821 (SLA-73-808) PURCHASING ORGANIZATION ANNUAL REPORT, JULY 1, 1972-JUNE 30, 1973. Search, W. S. Jr. (Sandia Labs., Albuquerque, N. Mex.). 1973. 17p. Dep. NTIS $4.00.

During FY 1973, the Sandia Albuquerque and Livermore Purchasing Organizations awarded 81,986 individual procurements totaling $69,044,000 to commercial contractors and 2722 individual procurements totaling $27,596,000 to AEC integrated contractors. This represented a decrease of 4% in the number of procurements and an increase of 10% in dollars committed compared with FY 1972. While total commitments increased, commercial procurements decreased from 74 to 71% of the total and integrated contractor procurements increased from 26 to 29% as compared to FY 72. The total number of contractors with whom Sandia conducted business declined from 9378 to 8822. There were 58,665 procurements totaling $30,109,000 awarded to small business contractors, representing 44% of total commercial dollar awards in FY 73 compared with 46% in FY 72. The Purchasing Organization also continued an aggressive program to increase the participation of minority-owned businesses in our procurement activity. The results were 2128 procurements for $1,149,000, a participation increase from 0.9 to 1.7% of commercial dollar awards over the previous year. (auth)

Mathematics and Computers

Refer also to abstract 26860.

26822 (AAEC/E-264) SIGNALLING CONVENTIONS FOR THE AAEC COMPUTER NETWORK. Richardson, D. J. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Apr 1973. 11p. Dep. NTIS (U.S. Sales Only) $3.00.

The signalling conventions to be used by AAEC network computers communicating with the IBM 360 computer are detailed and discussed. Provision is made for the temporary relinquishing of intermediate computer to computer links during such communications, and a local path command retry facility is made available. The signalling conventions presented are recommended for general AAEC computer network use. (auth)

26823 (ANL-8034) USE OF NETWORK JOB PROCESSING (NJP). Engert, D. E. (Argonne National Lab., Ill.). Aug 1973. Contract W-31-109-eng-38. 19p. Dep. NTIS $4.00.

This document describes the use of the NJP feature of ASP during a changeover period to an IBM System/360 model 75-195 computer system from an IBM System/360 model 50-75 computer system. NJP allows one ASP system to communicate with another by sending jobs back and forth between systems. However, the

three major elements of NJP, (1) a DSP called by the operator to create an NJPOPEN job; (2) a DSP created by NJP to open a line, using BTAM; and (3) a DSP that may be invoked by NJPOPEN to receive a job, or invoked by a job for transmitting, caused problems during the changeover, and it was found necessary to improve their functions. This paper brings to light several of these problems, presents solutions for some of them, and suggests improvements for the overall system. It is assumed that the reader has some knowledge of IBM systems and nomenclature. (auth)

26824 (BDX-613-973) SHAPING RATCHET TEETH. Technological Spinoff Report. Stiles, R. W. (Bendix Corp., Kansas City, MO). Aug 1973. Contract AT(29-1)-613. 23p. Dep. NTIS $3.25.

Gear shaping as a method of cutting teeth offers advantages not available in hobbing, form milling, and blanking. Bendix conducted cutting tests on a gear-shaping machine; as a result, a mathematical model and computer program for generation shaping were developed. The mathematical model has advanced generation shaping of noninvolute forms from trial and error to mathematical exactness. (auth)

26825 (COO-1469-225) DOCUMENTATION FOR DFASUB: A PROGRAM FOR THE SOLUTION OF SIMULTANEOUS IMPLICIT DIFFERENTIAL AND NONLINEAR EQUATIONS. Brown, R. L.; Gear, C. W. (Illinois Univ., Urbana. Dept. of Computer Science). Jul 1973. Contract AT(11-1)-1469. 41p. (UIUCDCS-R-73-575). Dep. NTIS $4.25.

This report surveys the theory of an efficient method for solving $f(y, y', t) + P(t)v = 0$ to get approximations to y(t) and v(t) at discrete time points $t_i > t_0$ given $y(t_0)$ and $y'(t_0)$. The organization and use of a program, DFASUB, which uses this theory is described. (auth)

26826 (COO-2118-39) SYNTHESIS OF TEXTURE. McCormick, B. H.; Jayaramamurthy, S. N. (Illinois Univ., Urbana. Dept. of Computer Science). Jul 1973. Contract AT(11-1)-2118. 41p. (UIUCDCS-R-73-566). Dep. NTIS $4.25.

A general method is proposed for the synthesis of texture. In this method, the pixels (picture elements) from a textural scene are considered as a two-way seasonal time series. With the help of well-developed methods in time-series analysis, a model is fitted for the above time series. From a set of boundary conditions, with the help of this model, the future values of the time series are generated which in essence are the pixels of the synthesized texture. The effectiveness of this procedure is illustrated with examples. (10 figures, 30 references) (auth)

26827 (COO-3077-28) SIMPLE LAMBDA-CALCULUS MODEL OF PROGRAMMING LANGUAGES. Abdali, S. K. (New York Univ., N. Y. Courant Inst. of Mathematical Sciences). Jul 1973. Contract AT(11-1)-3077. 59p. Dep. NTIS $5.00.

A simple correspondence between a large subset of ALGOL 60 language and lambda-calculus is discussed. With the aid of this correspondence, a program can be translated into a single lambda expression. In general, the representation of a program is specified by means of a system of simultaneous conversion relations among the representations of the program constituents. High-level programming language features are treated directly, not in terms of the representations of machine-level operations. The model includes input-output in such a way that when the representation of a (convergent) program is applied to the input item representations, the resulting combination reduces to a couple of the representations of the output items. This model does not introduce any imperative notions into the calculus; the descriptive programming constructs, such as expressions, and the imperative ones, such as assignments and jumps, are translated alike into pure lambda-expressions. The applicability of the model to the problems of proving program equivalence and correctness is illustrated by means of simple examples. (auth)

26828 (DP-MS-71-57) ADVANCED TECHNIQUES FOR ANALYSIS OF COMPUTER SYSTEM PERFORMANCE. Katonak, P. R. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.). 1971. 38p. (CONF-711080-1). Dep. NTIS $4.00.

From region 4 conference of the American Institute of Industrial Engineers; Augusta, Georgia, USA (21 Oct 1971).

The main purposes for the Savannah River Laboratory (SRL) performance analysis effort are outlined. Computer system performance analysis at SRL is separated into two distinct elements. The first of these is measurement that includes the use of software and hardware monitors to measure the characteristics of the system workload and the utilization of the various facilities. The second element is modeling and prediction which involves the use of benchmark tests and simulation models to predict the effect of implementing changes in operating strategies and hardware configurations. These techniques are described. (MOW)

26829 (EUR-5030) EURCYL: A COMPUTER PROGRAM TO GENERATE FINITE ELEMENT MESHES FOR CYLINDER-CYLINDER INTERSECTIONS. De Windt, P.; Reynen, J. (European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center). Aug 1973. 22p. Dep. NTIS (U.S. Sales Only) $3.25. EUR B.Fr. 40.-.

EURCYL is a computer program dealing with the automatic mesh generation of cylinder–cylinder intersections, with special attention to the thick-walled vessel–nozzle junctions with curved transitions. Linear, parabolic, and cubic isoparametric elements can be applied. The output consists of punched cards for topology and geometry. (auth)

26830 (HEDL-TME-73-55) SIMEX: SIMULATION EXECUTIVE WITH AUTOMATIC SCALING. Worth, G. A. (Hanford Engineering Development Lab., Richland, Wash.). Jun 1973. Contract AT(45-1)-2170. 50p. Dep. NTIS $5.45.

A simulation software package was created for operation on a PDP-9 digital computer. It was designed to utilize a high-level, equation-oriented language in an interactive simulation environment. It utilizes fixed-point calculations with all scaling of constants and equations being done automatically after the user scales the problem variables. All inputs and outputs are in an unscaled-number format. The system is structured around a task-oriented, real-time executive which incorporates a line-by-line compiler. The user may input commands either for direct execution or to become part of a stored program. Commands may be input and compiled at the same time that previously entered stored program commands are being executed. The SIMEX system allows any number of time-dependent integrations to be performed (within core limitations). The integration algorithm currently implemented is extremely fast, although not as accurate as many more sophisticated algorithims. A simulation benchmark problem was run, and it was found that SIMEX provided an execution speed that was eight times faster than any previously published results. SIMEX appears to provide more speed and more interactive capability than any other small digital computer software system currently available. (auth)

26831 (IS-3174) COMPUTER PROGRAM FOR SOLVING NONLINEAR SYSTEMS OF EQUATIONS. Georg, D. D.; Keller, R. F. (Ames Lab., Iowa). Jul 1973. Contract W-7405-eng-82. 22p. Dep. NTIS $3.25.

User instructions and documentation are presented for a FORTRAN program to solve nonlinear systems of equations. The iterative algorithm implemented in the program is a projection algorithm. During the solution of any problem, 1, 2, or 3 components of the approximate solution vector can be changed at each iteration step. (auth)

26832 (IS-3179) INTERACTIVE COMPUTER PROGRAMS FOR LINEAR AND NONLINEAR PROJECTION METHODS. Schmitz, J. A.; Georg, D. D.; Keller, R. F. (Ames Lab., Iowa). Jul 1973. Contract W-7405-eng-82. 46p. Dep. NTIS $4.50.

User instructions and documentation are given for two separate interactive programs. These interactive programs were designed to aid in the investigation of projection methods as a basis for solving linear and nonlinear systems of equations. At each iteration step, the user must specify the order k of the subspace being projected on where k = 1, 2, or 3, and the columns of the coefficient matrix or Jacobian matrix which form this subspace. (auth)

26833 (KFK-1669) METHOD FOR DYNAMIC STRUCTURING IN IBM FORTRAN. Buckel, G.; Hoebel, W. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Neutronenphysik und Reaktortechnik). 1973. 25p. (In German). Dep. NTIS (U.S. Sales Only) $3.25.

A method is described in order to realize dynamical structures in IBM-Fortran programs. The listings of all necessary auxiliary programs are given, as well as an example for demonstration. (GE)

26834 (KFK-1746) CONNECTION OF A CAE 510 COMPUTER TO THE CALAS SYSTEM FOR DATA ACQUISITION AND EVALUATION OF MULTIPARAMETER EXPERIMENTS. Ernst, A.; Lembach, W.; Rietzschel, K. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Angewandte Kernphysik). Jun 1973. 33p. (In German). Dep. NTIS (U.S. Sales Only) $3.75.

A program system for a computer–computer connection between CAE 510 and TR86, system CALAS is described. The software is divided into two modules, one module consisting of data acquisition and the dialog between the two computers, and the other one of the evaluation and interactive data reduction of multiparameter experiments. (GE)

26835 (ORNL-TM-4291) MAINTAIN CODE FOR USE IN MAINTAINING AND REVISING CARD IMAGE FILES ON TAPE. Trubey, D. K. (Oak Ridge National Lab., Tenn.). Aug 1973. Contract W-7405-eng-26. 20p. Dep NTIS $3.00.

The conversational Remote Batch Entry (CRBE) System is useful for on-line creating, editing, and storing text data on disk via the ORNL IBM 360/75. The on-line storage space is limited, however, and it is therefore necessary to copy data onto tape for off-line longer-term storage. The MAINTAIN code was written for this purpose. The code is stored on the AZZZZZ disk for shared use. Jobs using MAINTAIN may be submitted from CRBE, the PDP-10, or by other means. Normally the code uses input data to revise or add to data from one tape and writes a new tape which incorporates the desired changes. Data blocks in card image format are identified by a "file name" or entry name which simply consists of a sequence of normally up to 8 characters starting in column 1 on any record. It normally precedes a group of records which can be called a "file." The end of a file is the record $$END in the first five columns. (auth)

26836 (RL-73-32) KURLY: A PROGRAM FOR COMPUTING THE MAGNETIC FIELDS OF 2-DIMENSIONAL ARRAYS OF CONDUCTORS. Collie, C. J. (Rutherford High Energy Lab., Chilton (England)). May 1973. 13p. Dep. NTIS (U.S. Sales Only) $3.00.

A description is given of the method used by the magnet design program GFUN for computing the fields due to 2-dimensional current arrays. Also described is a program for using these methods independently for current only (iron-free) problems. (auth)

26837 (SLA-73-408(Pt.1)) HARD-COPY PLOTTER/PRINTER FOR THE XDS SIGMA-5 COMPUTER PROCESSING SYSTEM. Schulthesis, T. M. (Sandia Labs., Albuquerque, N. Mex.). May 1973. 73p. Dep. NTIS $5.75.

An on-line plotting system using the Gould 4800-11 was developed for use with the XDS Sigma-5 computer signal processing system. The functional capabilities of the Gould plotter are discussed, together with the hardware interface. The interface discussion includes the programming instructions associated with the interface, as well as logic diagrams, timing diagrams, and verbal description of the logic hardware. (auth)

26838 (SLA-73-408(Pt.2)) HARD-COPY PLOTTER/PRINTER FOR THE XDS SIGMA-5 COMPUTER PROCESSING SYSTEM. Schulthesis, T. M. (Sandia Labs., Albuquerque, N. Mex.). May 1973. 95p. Dep. NTIS $6.75.

This document supplements SLA-73-0408, Part I, which discusses development of the XDS Sigma-5 computer signal processing system. The supplement consists of two listings which cover the signal source and the pin wiring list for Sigma-5 computer to Gould electrostatic plotter interface unit. (auth)

26839 (SLA-73-534) FORTRAN VARIABLE NAMES AND SUBROUTINE DESCRIPTIONS FOR THE CHARRING MATERIALS ABLATION CODE. Lauger, L. M.; Kaestner, P. C.; Blackwell, B. F.; McIntyre, A. E.; McBride, D. D. (Sandia Labs., Albuquerque, N. Mex.). Aug 1973. 76p. Dep. NTIS (U. S. Sales Only) $6.00.

Information necessary to understand the internal functions of the Sandia Laboratories version of the Charring Materials Ablation computer code is presented. Included are descriptions of the code subroutines, explanation of the FORTRAN variables, and a brief discussion of the thermochemistry section. (auth)

26840 (SLA-73-561) CABLE DEVELOPMENT STATUS COMPUTER PROGRAM. Klamerus, L. J.; Voida, G.; Olson, H. C. (Sandia Labs., Albuquerque, N. Mex.). Jul 1973. 31p. Dep. NTIS $3.25.

A technique is described for getting up-to-date information on the status of cables under development by use of the PDP-10. A computer program is now operational on the PDP-10 and this report describes the procedure for using it. Through this program one can obtain: a list of all cables under development, information on a single component identified by its normal nomenclature, the cables under development for a weapons program, the cables on a particular material requirement schedule, or the cables on a particular purchase order. The program is written in a conversational mode for use by nonprogramming engineers. It is hoped that this rapid method of information retrieval can provide Sandia and Bendix engineers information they need on cable status while freeing the cable development engineers from so many development status queries and easing their problem of keeping an accurately up-dated file of cable development status. (auth)

26841 (SLA-73-661) USER'S GUIDE TO A COMPUTERIZED SA RESISTOR CATALOG (RESIS). Klamerus, L. J.; Payne, K. J. (Sandia Labs., Albuquerque, N. Mex.). Jul 1973. Dep. NTIS $4.50.

A computer program was written for the design selection of resistors belonging to certain preferred families. A data file was created on a PDP-10 disk storage area for rapid retrieval of pertinent information on selected resistors. The designer inputs construction type, fixed or variable, ohms, tolerance, and wattage. Input format of values was relaxed to allow minimum restriction to the nonprogramming engineer and conversational mode is used throughout. Use of the program is expected to save design time and promote standardization of resistor usage. (auth)

26842 (SLA-73-670) GAIN: AN INTERACTIVE GRAPHICS INTERFACE FOR CIRCUIT ANALYSIS PROGRAMS. Blazek, D. R.; Schkade, A. F. (Sandia Labs., Albuquerque, N. Mex.). Jul 1973. 24p. Dep. NTIS $4.00.

This document describes operating procedures for an electronic circuit design and analysis program employing the Sandia interactive graphics system. (auth)

26843 (SLA-73-5309) COMPUTER-GENERATED VISUAL DOCUMENTATION OF THEORETICAL STORE SEPARATION ANALYSES. Spahr, H. R. (Sandia Lab., Albuquerque, N. Mex.). 1973. 29p. (CONF-730925-2). Dep. NTIS $3.50.

From second JTCF/ALNNO aircraft/stores compatibility symposium, Sacramento, California, USA (18 Sep 1973).

A new Sandia Laboratories computer program, MOVIE1, is described that uses state-of-the-art techniques to provide rapid visual documentation of the theoretical store separation process at minimum cost. Black and white drawings of two theoretical store separation analyses are presented to illustrate the visual documentation provided. Color and black and white 35mm slides and color and black and white movies (with real time and slow motion sequences) of the theoretical store separation process can also be generated. Techniques discussed reduce the computer time required for one theoretical store separation to a few seconds to generate the magnetic tape for drawings and to a few minutes to generate a magnetic tape for movies. Several possible future refinements and future extensions to the computer program are discussed. (auth)

26844 (SU-326-P-30-27) FOURIER–TOEPLITZ METHODS FOR SEPARABLE ELLIPTIC PROBLEMS. Fischer, D.; Golub, G.; Hald, O.; Leiva, C.; Widlund, O. (Stanford Univ., Calif. Dept. of Computer Science). Jul 1973. Contract AT(04-3)-326. 38p. (STAN-CS-73-375). Dep. NTIS $4.00.

Some very fast numerical methods have been developed in recent years for the solution of elliptic differential equations which allow for separation of variables. In this paper a Fourier–Toeplitz method is developed as an alternative to the well-known methods of Hockney and Buneman. It is based on the Fast Fourier transform and Toeplitz factorizations. The use of Toeplitz factorizations combined with the Sherman–Morrison formula is also systematically explored for linear systems of algebraic equations with band matrices of Toeplitz, or almost Toeplitz, form. Finally, results of numerical experiments are described. (auth)

26845 (SU-IPR-507) ON-LINE SPLINE FITTING. Buneman, O. (Stanford Univ., Calif. Inst. for Plasma Research). Feb 1973. Contract AT(04-3)-799. 27p. Dep. NTIS $3.50.

When splines are fitted to a set of data, the coefficients for any interval are sensitive to all the data but, by limiting the precision, one can effectively generate cubic splines over a data base of only 15 entries. Four multiplications per entry are needed to generate the coefficients while these data are being supplied. Sub-tabulation and spline drawing can therefore proceed "on line" with only a seven-step delay behind the data feed. (auth)

26846 (UCID-16331) LECTURE SERIES ON NONLINEAR LEAST SQUARES. Byrne, D. G. (California Univ., Livermore. Lawrence Livermore Lab.). Jul 1973. Contract W-7405-eng-48. 27p. Dep. NTIS $3.50.

This series of tutorial lectures on nonlinear least squares was presented July 16, 18, and 20, 1973. The series describes the least-squares problem, with some old methods and a new method for solving it. (auth)

26847 (UCID-16341) STORES STOCK MICROCOMPUTER SYSTEM: THE MCS-8 8-BIT PROCESSOR CONTROLLER. Fisher, E.; Spann, J.; Olken, H.; Goodman, R.; Nielsen, S. (California Univ., Livermore. Lawrence Livermore Lab.). 10 Jul 1973. Contract W-7405-eng-48. 15p. Dep. NTIS $3.00.

The desired microcomputer becomes immediately available because the standard functional modules (circuit boards), of which it is composed, and the standard chassis in which they are mounted, are all available as off-the-shelf items kept on hand in LLL Stores Stock. This is a major turning point in the history of computers because the computer user can now get a computer custom made (tailored) to his application, can have it quickly, by combination of off-the-shelf elements; and at low cost (about $500). The details of this revolutionary stage in computer technology, as developed at LLL, are described under several major headings. (LMT)

26848 (UCID-30063) FR80 REPORT WRITER. Storch, N. (California Univ., Livermore. Lawrence Livermore Lab.). 18 Jun 1973. Contract W-7405-eng-48. 19p. Dep. NTIS $3.00.

Formatted reports can be prepared interactively on a CDC 7600 using the "RED" dialect of the TRIX language. Features included in formatting are table of contents, indexing, cross-refer-

encing, headings, footings, footnotes, page numbering, and line justification with filling. These reports can be plotted on the FR80 which is a computer microfilm recorder. The reports can be produced on microfiche, 16 or 35-mm film. Also, printing plates can be made from the 35-mm film. Certain conventions used by the program which translates formatted ASCII reports to FR80 commands are described. (LMT)

26849 (UCRL-13573) MANUAL FOR INVESTIGATION OF COMPUTER-RELATED INCIDENTS OF INTENTIONALLY CAUSED LOSSES, INJURIES, AND DAMAGE. Parker, D. B. (California Univ., Livermore. Lawrence Livermore Lab.). Feb 1973. Contract W-7405-eng-48. 72p. Dep. NTIS $5.75.

The following topics are outlined: (1) sources of incident reportings and information, (2) timing of investigations, (3) investigative methodology, and (4) questionnaire description and usage. (MOW)

26850 (UCRL-13574) THREATS TO COMPUTER SYSTEMS. Parker, D. B. (California Univ., Livermore. Lawrence Livermore Lab.). Mar 1973. Contract W-7405-eng-48. 116p. Dep. NTIS $8.00.

This report describes the results of interdisciplinary investigation and analysis of threats to the security of multiaccess, on-line computer systems and the development of a methodology for future similar investigations and analyses. The research was conducted in the Information Science Laboratory of SRI's Information Science and Engineering Division. The major activities included visits to computer manufacturers and computer service organizations; office and field investigation of incidents; attendance at conferences and a workshop; and meetings with the RISOS Project staff. (auth)

26851 (UCRL-74894) PARALLEL IMPLEMENTATION OF A TWO-DIMENSIONAL MODEL. Kransky, V. J.; Giroux, E. D.; Long, G. A. (California Univ., Livermore. Lawrence Livermore Lab.). 23 Jul 1973. 11p. (CONF-730832-1). Dep. NTIS $3.00.

A large, serially programmed, two-dimensional mathematical model was reprogrammed for the CDC STAR-100 and the CDC 7600 computers using parallel programming techniques. The parallel program is currently running on the CDC 7600. The concepts, techniques, and the results of its use are discussed. The parallel program executes efficiently, can be modified easily, and requires no major redesign or reprogramming for conversion to other large-scale parallel machines. (auth)

26852 (UIUCDCS-R-72-526) STABILITY AND CONVERGENCE OF GENERAL MULTISTEP AND MULTIVALUE METHODS WITH VARIABLE STEP SIZE. Tu, K. W. (Illinois Univ., Urbana. Dept. of Computer Science). Jul 1972. 91p.

Thesis.

A detailed discussion is given on variable-step-size multistep methods which are generalizations of $\Sigma_{i=0}^{k} (\alpha_i y_{n-i} + h\beta\ f_{n-i}) = 0$ (auth)

Miscellaneous

26853 (AEC-tr-7459) INSTALLATION FOR WATER DEOXYGENATION. Durel, D. H. G. 24 Feb 1967. Translation of French Patent 1,470,438. 8p. Dep. NTIS $3.00.

The installation adds hydrazine in proportion to the flow rate and in inverse proportion to the temperature of the water. (DLC)

26854 (ARL-MET-1) BIBLIOGRAPHY ON STRESS WAVE EMISSION, 1950–1972. Martin, G. G. (Aeronautical Research Labs., Melbourne (Australia)). Feb 1973. 44p. Dep. NTIS (U.S. Sales Only) $4.25.

Known sources of information relating to stress wave emission have been collected and listed under two headings—articles readily available in Australia and those available elsewhere. (auth)

26855 (BDX-613-844(Rev.)) DESIGN OF A WIRE TENSIONING DEVICE. Bradley, J. O. (Bendix Corp., Kansas City, MO). Aug 1973. 28p. Dep. NTIS $4.00.

An experimental pneumatic wire tensioner and a frictional wire tensioner were fabricated and evaluated with respect to the requirements of weaving AWG 33 magnet wire into 90-conductor tape. The frictional tensioner, redesigned to reduce variations in wire tension, is expected to provide reliable control over the wire-weaving process when incorporated into a creel. (auth)

26856 (BDX-613-933) LASER CENTERING DETECTOR. Technological Spinoff Report. Wonnell, L. D. (Bendix Corp., Kansas City, MO). Jul 1972. Contract AT(29-1)-613. 15p. Dep. NTIS $4.00.

A compact, battery-powered laser centering detector, constructed specifically for use with the low-power output of laser interferometers to align the interferometers and to measure machine pitch and yaw errors with a resolution of 100 microinches (2.54 μm), was designed, built, and evaluated by the Bendix Meteorology Laboratory. (auth)

26857 (BDX-613-941) RISE-RATE TESTING OF URETHANE FOAMS. Final Report. Neet, T. E. (Bendix Corp., Kansas City, MO). Jul 1973. Contract AT(29-1)-613. 52p. Dep. NTIS $4.75.

The effects of variations in processing parameters and material formulations on the rise-rate characteristics and physical properties of rigid urethane foams were evaluated. Of the eight variables studied, only the component temperature, mix ratio, water concentration, and material reactivity significantly altered the rise-rate results. The physical properties of the foams were not appreciably changed. (auth)

26858 (BDX-613-942) OMNI-DIRECTIONAL ILLUMINATION FOR PRINTED CIRCUIT BOARD INSPECTION. Technological Spinoff Report. Taylor, R. D. (Bendix Corp., Kansas City, MO). Aug 1973. Contract AT(29-1)-613. 23p. Dep. NTIS $4.00.

The need to improve illumination for the visual inspection of printed circuit boards and other assemblies produced at Bendix Kansas City prompted the development of omni-directional illumination. The improved lighting technique employs an integrated sphere which reflects light from all points on its internal, magnesium oxide-coated surface onto the object under inspection. Totally indirect lighting results, and the object viewed is without shadow or glare. Spheres of 3, 8, and 30 inches (7.5, 20, and 76 cm) in diameter were developed in addition to a hemisphere or dome illuminator. (auth)

26859 (BNL-17854) PHOTOMETRIC MEASUREMENT OF THE IMMUNOFLUORESCENCE INTENSITY OF GROUP D STREPTOCOCCI. Pavlova, M. T.; Beauvais, E.; Brezenski, F. T.; Litsky, W. (Brookhaven National Lab., Upton, N. Y.). [nd]. 10p. (CONF-730534-1). Dep. NTIS $3.00.

From 73rd annual meeting of the American Society for Microbiology; Miami Beach, Florida, USA (6 May 1973).

26860 (BNL-18080) MEASUREMENT OF DEFORMATIONS IN ENGINEERING STRUCTURES BY COMPUTERIZED FILM SCAN METHODS. Powell, J. R.; Kopp, J.; Reich, M. (Brookhaven National Lab., Upton, N. Y.). May 1973. 70p. Dep. NTIS $5.50.

The suitability of computer-assisted film scan methods for measurements of deformations in engineering structures is tested under controlled laboratory conditions. Photographically measured displacements of markers are compared to their known displacements using several cameras under a variety of conditions, and the accuracy of measurement is evaluated. The known market movements could be measured with an average error of ±5 mils in real space for a camera-to-marker distance of 35 feet, using a standard 55-mm camera lens. (MOW)

26861 (CEA-R-4350) LIQUID–LIQUID EXTRACTION. Transient Region Studies. Effect of Hydrodynamics on the Operation of the Equipment. Demarthe, J. M. (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). Feb 1973. 145p. (In French). Dep. NTIS (U. S. Sales Only) $9.25.

Thesis. Submitted to Paris Univ. (France). Faculte des Sciences.

26862 (CEA-R-4395) MANUFACTURE OF NONVOLATILE MEMORIES BY DEPOSITING SILICON NITRIDE FILMS ON SILICON OXIDE. Gentil, P. (Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires). Aug 1973. 127p. (In French). Dep. NTIS (U.S. Sales Only) $8.50.

Thesis. Submitted to Universite Scientifique et Medicale de Grenoble (France).

The characteristics and applications of a new memory structure are reviewed. The element is an insulated gate field-effect transistor, the silicon dioxide gate insulator of which being replaced by a double insulator (typically a 20 to 30 Å layer of SiO_2 and a layer of silicon nitride (Si_3N_4) about 600 Å). A high electrical field modifies the charges at the dielectric interface and consequently the value of the threshold voltage. The variations of the threshold voltage are observed as a function of the height and the duration of the writing pulse between metallic and silicon electrodes, for several oxide thicknesses. The loss of the information, after the writing pulse is reduced to zero, is observed as a function of a dc bias, for several values of the initial threshold voltage and as a function of the oxide thickness. All the characteristics are practically independent of the temperature. (MOW)

26863 (CEA-R-4455) CONTRIBUTION TO THE STUDY OF KIRKENDALL EFFECT. Cornet, J. F. (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). Jul 1973. 142p. (In French). Dep. NTIS (U. S. Sales Only) $9.25.

Thesis. Submitted to Univ., Lyon.

An analysis of the Kirkendall effect in terms of Darkens's equations (Trans. AIME, 175: 184(1948)) permits an exact description of the behavior of a diffusion couple A/B in terms of the intrinsic diffusion coefficients D_A and D_B. (44 figures, 28 references) (auth)

26864 (CONF-730458-1) ULTRASTRUCTURAL ASPECTS OF GENETIC ACTIVITY. Hamkalo, B. A.; Miller, O. L. Jr.; Bakken, A. H. (Oak Ridge National Lab., Tenn; Yale Univ., New Haven, Conn. (USA). Dept. of Biology). [nd]. 9p. Dep. NTIS $3.00.

From symposium on molecular cytogenetics; Gatlinburg, Tennessee, USA (9 Apr 1973).

Electron-microscopic analysis of the material released by gentle lysis of prokaryotic and eukaryotic cells has provided information on the in vivo structure of transcription complexes. Active nonribosomal and ribosomal RNA genes in both cell types have been identified (for reviews see Miller and Hamkalo, 1972; Hamkalo and Miller, 1973). This paper summarizes the comparative structural features of these two types of transcription in three eukaryotic cells (HeLa, Drosophila, and yeast). (auth)

26865 (CONF-730803-4) STATISTICAL REGRESSION ANALYSIS OF EXPERIMENTAL DATA FOR FLOW FILM-BOILING HEAT TRANSFER. Slaughterbeck, D. C.; Vesely, W. E.; Ybarrondo, L. J.; Condie, K. G.; Mattson, R. J. (Aerojet Nuclear Co., Idaho Falls, Idaho). [nd]. 12p. Dep. NTIS $3.00.

From national heat transfer conference; Atlanta, Georgia, USA (5 Aug 1973).

Large discrepancies exist among predictions of heat-transfer coefficients obtained from various existing flow film-boiling correlations and between the correlations and experimental data. A statistical regression analysis was performed on available film-boiling data to provide a better method of predicting conservative (low) heat transfer coefficients, to quantify the uncertainties in the predicted heat transfer coefficients, and to obtain a knowledge of error trends encountered when the correlations are extrapolated beyond the range of experimental data. The present study is limited to a statistical analysis of the available data for steady-state-flow film boiling in vertical tubes. (auth)

26866 (CONF-730833-1) OPTICAL PROPERTIES OF LIQUIDS IN THE VACUUM uv. Birkhoff, R. D.; Hamm, R. N.; Williams, M. W.; Arakawa, E. T.; Painter, L. R. (Oak Ridge National Lab., Tenn.; Tennessee Univ., Knoxville). 1972. 19p. Dep. NTIS $3.00.

Dielectric and optical data, mostly from literature, are presented for: liquid benzene, 1,3-cyclohexadiene, cyclohexene, cyclohexane, water, glycerol, silicon pump oils, and CCl_4. (11 figures, 20 references) (DLC)

26867 (CONF-730924-1) COMPARISON OF BELOWGROUND BIOMASS OF NATURAL DECIDUOUS FORESTS AND LOBLOLLY PINE PLANTATIONS. Harris, W. F.; Kinerson, R. S. Jr. (Oak Ridge National Lab., Tenn.; Duke Univ., Durham, N. C. Dept. of Botany). 1973. 32p. Dep. NTIS $3.75.

From symposium on below ground ecosystem; Fort Collins, Colorado (5 Sep 1973).

26868 (COO-1332-87) RAPTOR CONSERVATION AND MANAGEMENT APPLICATIONS OF BIO-TELEMETRY STUDIES FROM CEDAR CREEK NATURAL HISTORY AREA. Fuller, M. R.; Nicholls, T. H.; Tester, J. R. (Minnesota Univ., St. Paul (USA). Dept. of Ecology and Behavioral Biology). (nd). 16p. (CONF-730340-1). Dep. NTIS $3.00.

From conference on raptor conservation techniques; Ft. Collins, Colorado, USA (22 Mar 1973).

26869 (COO-1332-89) AUTOMATIC RADIO TRACKING SYSTEM FOR BIOTELEMETRY. Fuller, M. R.; Tester, J. R. (Minnesota Univ., St. Paul (USA). Dept. of Ecology and Behavioral Biology). [nd]. 4p. (CONF-730340-3). Dep. NTIS $3.00.

From conference on raptor conservation techniques; Ft. Collins, Colorado, USA (22 Mar 1973).

26870 (COO-1332-94) ACCURACY AND OPTIMIZATION OF TRACKING SYSTEMS. Sanford, R. L. (Minnesota Univ., St. Paul (USA). Dept. of Ecology and Behavioral Biology). Aug 1973. Contract AT(11-1)-1332. 225p. Dep. NTIS $13.25.

Thesis.

A decision theoretic model designed to aid in the creation, development, and critical evaluation of automatic tracking systems is presented. This model is specifically designed for tracking systems which use two directional Yagi antennas to estimate the unknown location of a radio-carrying animal by mathematical triangulation. The approach taken is stochastic in nature and involves the quantification of a tracking system's performance by a probabilistic treatment of radio-wave propagation as well as a probabilistic treatment of the propagation of errors during bearing determination and position estimation. Estimation results basic to extending this approach to three-tower tracking systems are given. The usefulness and flexibility of the two-tower tracking system model is demonstrated by considering possible improvements in the Cedar Creek Tracking System owned and operated by the University of Minnesota. To do this the consequences of proposed system improvements are evaluated by computer simulation. Indications of how this decision theoretic approach can be extended to other design questions in the field of biotelemetry are given. (auth)

26871 (COO-2121-17) CYTOGENETICS OF MONOSOMES IN ZEA MAYS. Progress Report, October 1, 1972–September 30, 1973. Weber, D. F. (Illinois State Univ., Normal. Dept. of Biological Sciences). 1973. Contract AT(11-1)-2121. 32p. Dep. NTIS $3.75.

Progress on studies of the following are reported: the cytology of meiosis, the cytological behavior of univalent chromosomes, and recombination in heterozygous bivalents in Zea mays monosomes; the frequency and types of spontaneous chromosome aberrations in progeny of monosomes; the effect of monosomy on lipid content; and determining if gene magnification occurs in monosomic 6 plants. (auth)

26872 (COO-2314-1) NOISE THERMOMETER FOR TEMPERATURES FROM ABOVE 300K TO BELOW 4K. Anderson, P. T.; Pipes, P. B. (Dartmouth Coll., Hanover, N. H. (USA). Dept. of Physics and Astronomy). 1972. Contract AT(11-1)-2314. 15p. Dep. NTIS $3.00.

The description of a solid-state noise thermometer is given and its use is discussed. Temperatures between 300K and 4.2K have been measured to better than 1% with a time constant of 5 seconds. (auth)

26873 (COO-3010-8) MICROPUNCTURE INVESTIGATION OF THE WHOLE-TISSUE MECHANISM OF ELECTROLYTE SECRETION BY THE IN VITRO RABBIT PANCREAS. Swanson, C. H.; Solomon, A. K. (Harvard Medical School, Boston, Mass.). 1971. Contract AT(30-1)-24531. 46p. Dep. NTIS $4.50.

26874 (COO-3400-20) CALCIUM METABOLISM IN DAIRY COWS. Kronfeld, D. S.; Mayer, G. P.; Ramberg, C. F. Jr. (Pennsylvania Univ., Kennett Square. School of Veterinary Medicine). 1972. 10p. (CONF-720733-1). Dep. NTIS $3.00.

From production disease conference; Reading, UK (Jul 1972).

26875 (INR-1446) RESPONSE OF INERTIAL NONLINEAR CIRCUIT WITH DEAD ZONE TO THE STEP FUNCTION OF THE INPUT SIGNAL FORMED BY A LINEAR INERTIAL CIRCUIT. Gasiorowski, L. (Institute of Nuclear Research, Warsaw (Poland)). 1973. 47p. (In Polish). Dep. NTIS (U.S. Sales Only) $4.50.

26876 (IPP-III-9) NEW DIFFRACTION ANOMALIES AND BACKSCATTERING RESONANCE ON A GRATING OF TRIANGULAR CROSS SECTION. Sesnic, S.; Jovicevic, S. (Max-Planck-Institut fuer Plasmaphysik, Garching (West Germany). May 1973. 43p. Dep. NTIS (U.S. Sales Only) $4.25.

The solution to the problem of diffraction of a parallel- and perpendicular-polarized wave from an echelette grating is discussed with a special emphasis on diffraction anomalies. Two new kinds of anomalies are described: the first occurs when the phase change of the incident wave over the groove is equal to a multiple of π; the second occurs when this phase change is equal to an odd multiple of $\pi/2$. The first can coincide with a double Rayleigh anomaly which then, for a perpendicular-polarized wave, results in an amplified anomaly. If, additionally, one of the grating orders in the double Rayleigh anomaly is +1 order, a resonant-type anomaly results. This resonance anomaly could be utilized in a laser cavity or for the purpose of the spectral or spatial filtering. (auth)

26877 (IS-T-588) LOW-TEMPERATURE HEAT CAPACITIES OF ONE-DIMENSIONAL SYSTEMS: DIMETHYLAMMONIUM TRICHLOROCUPRATE(II) AND TETRAMETHYLAMMONIUM TRICHLORONICKELATE(II). Hurley, M. D. (Ames Lab., Iowa). May 1973. Contract W-7405-eng-82. 85p. Dep. NTIS $6.25.

Thesis.

Results of measurements at 0.6 to 29°K indicate that three-dimensional interactions are not negligible compared to those in one dimension. The interactions were fit to the spin 1, antiferromagnetic Heisenberg model. (DLC)

26878 (IS-T-589) ELECTROPHILIC CLEAVAGE REACTIONS OF SOME ALKYL TRANSITION METAL SIGMA BONDS. Williams, D. A. (Ames Lab., Iowa). May 1973. Contract W-7405-eng-82. 83p. Dep. NTIS $6.25.

Thesis.

Results of a study of the electrophilic cleavage of alkylchromium(III) complexes by bromine is presented. (auth)

26879 (IS-T-599) I. APPLICATION OF 1,10-PHENANTHROLINE TO THE SPECTROPHOTOFLUOROMETRIC ANALYSIS OF ZINC AND CADMIUM. II. Partially Sulfonated, Macroreticular Ion Exchange Resins in the Separation of Metal Ions. Story, J. N. (Ames Lab., Iowa). Sep 1973. Contract W-7405-eng-82. 137p. Dep. NTIS $9.00.
Thesis.

26880 (IS-T-597) TUNGSTEN BRONZES AS INDICATING POTENTIOMETRIC ELECTRODES. Hahn, P. B. (Ames Lab., Iowa). Sep 1973. Contract W-7405-eng-82. 103p. Dep. NTIS $7.25.
Thesis.
Alkali metal tungsten bronzes, highly conducting nonstoichiometric compounds of formula M_xWO_3 with $0 < x < 1$, were studied as potentiometric indicating electrodes in aqueous solution. (44 figures, 96 references) (DLC)

26881 (IS-T-602) MECHANISTIC STUDIES ON METALLOPORPHYRINS AND VITAMIN B_{12}. Sellers, T. D. Jr. (Ames Lab., Iowa). Sep 1973. Contract W-7405-eng-82. 143p. Dep. NTIS $9.25.
Thesis.
Two biochemical model systems were studied: (1) oxidation of iron (II) protoporphyrin IX with $Fe(CN)_6^{3-}$ and $Fe(CN)_5OH^{3-}$, and (2) reaction of Cr (II) with alkylcobalamins. (DLC)

26882 (IS-T-609) VAPORIZATION AND THERMODYNAMICS OF VANADIUM MONOSULFIDE. Owzarski, T. P. (Ames Lab., Iowa). Sep 1973. Contract W-7405-eng-82. 244p. Dep. NTIS $14.25.
Thesis.

26883 (ITF-73-66-P) TEMPERATURE DEPENDENCE OF EFFICIENCY OF THE DONOR-ACCEPTOR ENERGY TRANSFER. Serikov, A. A.; Trofimov, A. S.; Khomenko, Yu. M. (Akademiya nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1973. 49p. (In Russian). Dep. NTIS (U. S. Sales Only) $4.50.
The temperature dependence of efficiency of the acceptor luminescence is theoretically investigated using the simplest donor–acceptor systems. The consideration was performed, analyzing the equations of the density matrix evolution of the "open" dynamic system which interacts with the thermostat and radiation field. It is shown that the character of such a dependence is essentially sensitive to the energy spectrum structure of molecules of the donor and acceptor and also the quantum properties of the environment—the thermostat. (tr-auth)

26884 (ITF-73-81-E) ROLE OF SPATIAL DISPERSION IN A QUADRUPOLE LIGHT ABSORPTION. Davydov, A. S.; Eremko, A. A. (Akademiya nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1973. 17p. Dep. NTIS (U. S. Sales Only) $3.00.
The phenomenological Maxwell equations are used to investigate the passage of light through a crystal in a frequency range that corresponds to an isolated band of exciton states of the quadrupole type. The conditions under which the singularities connected with the wave-vector dependence of the exciton frequency may occur are found. Under these conditions an oscillating dependence of the light transmission coefficient on the crystal width may come into play (when the width is small). The calculated results are compared with the Gorban–Timofeev experiment (Dokl. Akad nauk SSSR, 140: 791(1961)) with Cu_2O in the quadrupole exciton absorption region when $\lambda = 6125$ Å. (auth)

26885 (JAERI-M-5223) HIGH-POWER X-RAY GENERATOR FOR IRRADIATIONS. Oshima, Y.; Watanuki, T.; Kameyama, K.; Tanaka, R. (Japan Atomic Energy Research Inst., Tokyo). May 1973. 64p. (In Japanese). NTIS (U.S. Sales Only).
The high-power x-ray generator was constructed for research in radiation chemistry and food irradiation in the Takasaki Radiation Chemistry Research Establishment. The power of 200 kV, 1 A is supplied from a transformer to the x-ray tube, which is suspended below it. The filament unit is of two components, each with 16 parallel tungsten wires, 0.3 mm in diameter and 170 mm long. X rays are generated at the gold-plated (30 μm) copper targets cooled with water. To have stabilized operation of the high-power generator, many technical difficulties were encountered and subsequently solved. It is now in operation at the design output of 2×10^4 R/min at 5 cm from the target, with the possibility of long-term, continuous irradiation. Construction of the generator, its improvements, and the irradiation characteristics are described. (auth)

26886 (JEN-258) POTABILIZATION OF BRACKISH WATER BY ELECTRODIALYSIS. Study of Natural Samples with a Laboratory Unit. Sainz Sastre, J. A.; Alonso-Lopez, J. (Junta de Energia Nuclear, Madrid (Spain)). 1972. 13p. (In Spanish). Dep. NTIS (U.S. Sales Only) $3.00.

26887 (JEN-263) OPTIMIZATION OF GAS-CHROMATOGRAPHIC SEPARATIONS. Gasco Sanchez, L. (Junta de Energia Nuclear, Madrid (Spain)). 1973. 45p. (In Spanish). Dep. NTIS (U.S. Sales Only) $4.25.

26888 (JINR-E4-7184) SOME QUANTITATIVE RESULTS OF THE STATIONARY BEHAVIOR OF A SOLID-STATE ANTI-STOKES RAMAN OSCILLATOR. Welsch, D. G. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 18p. Dep. NTIS (U.S. Sales Only) $3.00.
Frequency, damping, and coupling dependence of the steady-state photon numbers, threshold value, and frequency shifts of a solid-state anti-Stokes Raman oscillator are investigated. Some numerical results are presented. (auth)

26889 (JINR-P5-7259) PROGRAM FOR SOLVING NONLINEAR SYSTEMS OF EQUATIONS ON THE BASIS OF REGULARIZATION ITERATION PROCESSES BY GAUSS–NEWTON. Aleksandrov, L. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation). 1973. 72p. (In Russian). Dep. NTIS (U. S. Sales Only) $5.75.

26890 (LA-5340-PR) DEVELOPMENT OF A MULTISTAGE TANDEM AIR SAMPLER FOR MERCURY. LASL Project R-060. Quarterly Report, January 1–March 31, 1973. (Los Alamos Scientific Lab., N. Mex.). Jul 1973. Contract W-7405-eng-36. 14p. Dep. NTIS $4.00.
Several sorbing materials were evaluated to determine their retention of metallic mercury, CH_3HgCl, and $(CH_3)_2Hg$ vapors. An objective of this evaluation was to find materials that would selectively collect one form of mercury with the exclusion of the other. Included in the study was the evaluation of silver wool to determine its ability to retain metallic mercury, CH_3HgCl, and $(CH_3)_2Hg$. Test methods and results are presented. (LMT)

26891 (LA-5353-T) THEORETICAL CALCULATIONS OF CONFORMATIONS OF THE ADENOSINE MONO-, DI-, AND TRIPHOSPHATE MOLECULES. Engelke, S. Z. (Los Alamos Scientific Lab., N. Mex.). Aug 1973. Contract W-7405-eng-36. 356p. Dep. NTIS $10.60.
Thesis.

26892 (LBL-1157) PERFLUORO CATIONS OF THE NONMETALLIC ELEMENTS. Gibler, D. D. (California Univ., Berkeley. Lawrence Berkeley Lab.). Apr 1973. Contract W-7405-eng-48. 104p. Dep. NTIS $7.25.
Thesis.
Crystal structures of $XeF^+RuF_6^-$, $SF_3^+BF_4^-$, $SAsF_9$, and $IF_4^+SbF_6^-$ were determined. The fluoride ion donor properties of the fluorides of groups VI to VIII are discussed; the relative donating abilities of IF_7 and IF_5 were studied. A new synthesis of IOF_5 is reported. Preparation and properties of $NO_2^+WOF_5^-$ and $NO_2^+IrF_6$ are described. (DLC)

26893 (LBL-1566) VIRAL ONCOGENESIS AND CHEMICAL CONTROL. Calvin, M. (California Univ., Berkeley. Lawrence Berkeley Lab.). Jan 1973. Contract W-7405-Eng-48. 42p. (CONF-730657-1). Dep. NTIS $4.25.
From 2nd Duran-Reynals international symposium on viral replication and cancer; Barcelona, Spain (21 Jun 1973).

26894 (LBL-1814) PREPARATIVE AND STRUCTURAL STUDIES INVOLVING NOBLE-GAS AND RELATED COMPOUNDS. McKee, D. E. (California Univ., Berkeley. Lawrence Berkeley Lab.). May 1973. Contract W-7405-eng-48. 93p. Dep. NTIS $6.75.
Thesis.
$KrF_2 \cdot 2SbF_5$ was studied; its reactions with IF_5, $XeOF_4$, BrF_5, and ClF_5 were investigated. The $XeF_4 \cdot xSbF_5$ and $XeOF_4 \cdot xSbF_5$ and the $O_2F \cdot xSbF_5$ systems ($x = 1$ and 2) were studied. Oxidation of Xe by IF_7 is described. (DLC)

26895 (LBL-1845) PHOSPHORESCENCE-MICROWAVE-DOUBLE RESONANCE IN EXCITON STATES OF MOLECULAR CRYSTALS AND COHERENT STATES OF TRIPLET SPIN ENSEMBLES. Harris, C. B. (California Univ., Berkeley. Lawrence Berkeley Lab.). Jun 1973. 20p. (CONF-730558-1). Dep. NTIS $3.00.
From 11th European congress of molecular spectroscopy conference; Tallinn, USSR (28 May 1973).
Relationships between PMDR spectroscopy, coherent triplet exciton migration, and density of states in molecular crystals are given for one-dimensional molecular crystals. Experimental data for tetrachlorobenzene are given and interpreted. Methods using optically detected electron spin echoes and echo trains are given. (DLC)

26896 (LBL-2059) BINDING OF NINHYDRIN TO AMINO ACIDS, PEPTIDES, AND PROTEINS: STUDIES BY ELECTRON PARAMAGNETIC RESONANCE SPECTROSCOPY. Allen, J. K.

(California Univ., Berkeley. Lawrence Berkeley Lab.). Jun 1973. Contract W-7405-Eng-48. 224p. Dep. NTIS $13.25.
Thesis.

26897 (NIIAR-P-143) DISTURBANCE FIELD AROUND DEFECTS. Kazachkovskii, O. D. (Scientific Research Atomic Reactor Inst., Melekess (USSR)). 1972. 32p. (In Russian). INIS.
Field excitation parameters around a defect were determined in spherical geometry. The problem was solved by a direct method on the basis of continual representations in the linear theory of elasticity. The normalized solutions obtained permitted a simple treatment and may be quantitatively compared with experiment–x-ray data, for example. (tr-auth)

26898 (NP-19843) CYTOGENETICS OF MONOSOMES IN ZEA MAYS. Comprehensive Report, October 1, 1970–September 30, 1973. Weber, D. F. (Illinois State Univ., Normal. Dept. of Biological Sciences). 1973. Contract AT(11-1)-2121. 30p. Dep. NTIS $3.50.

26899 (NRC-TT-1615) SUBSIDENCE DUE TO COAL MINING IN THE HARBOURS OF RUHRORT. Bumm, H. Translated by Robert Serre (National Research Council of Canada, Ottawa) from Jahrb. Hafenbautech. Ges.; 30/31: 29-38(1966/). 26p. Dep. NTIS (U. S. Sales Only) $3.50.
Ground settlement due to underground activities such as mining or pumping of gas, oil, or water is frequently encountered and often causes serious damage and economic loss. However, at the harbors of Duisburg–Ruhrort on the Rhine, settlement of the harbor area was deliberately induced by coal mining under the harbor in order to compensate for reduced water level which was the result of long-term erosion of the river banks and bottom. Six harbor docks were to be lowered by 1.60 to 2.00 m and two entrance locks were to be lowered by 2.25 m as partial compensation for the 4.00 m erosion of the Rhine. The mining processes used during coal extraction, the damage caused by the mining operations, and the results achieved are discussed. Coal was extracted in three dock areas, and the planned subsidences were achieved. A fault was discovered which extended under the Ruhr lock and north harbor area so further extraction was forbidden. Mining under the harbor ended in 1968. The project was successful in that subsidences and their consequences were predicted with great precision, damage was kept within reasonable limits, and the remarkable feat of lowering the complex harbor structures by 2.00 m was achieved. (LCL)

26900 (ORNL-TM-4278) OPTIMIZATION OF THE KRATKY SMALL ANGLE X-RAY SCATTERING COLLIMATION SYSTEM PARAMETERS. Shaffer, L. B.; Hendricks, R. W. (Oak Ridge National Lab., Tenn.). Sep 1973. Contract W-7405-eng-26. 113p. Dep. NTIS $7.75.
Analytic expressions are given that describe the power through a Kratky collimation system such as is commonly used in small-angle x-ray-scattering experiments. These expressions account for any size and position of the focal spot relative to the entrance slit in the width direction. An expression for the "infinite" beam geometry is given for the length direction. Expressions are also presented for the minimum experimentally accessible angle (including parasitic scattering) and for the maximum angle to which the "infinite beam" assumption is valid. Subject to the constraint of a predetermined and fixed minimum angle the positions and widths of all slit edges are optimized to achieve maximum power through the collimation system for the case of a fully and non-fully illuminated entrance slit. Complete details of the analytic derivation are given. A comparison of the theoretical optimization with experimental data is also given. (auth)

26901 (ORNL-tr-2696) FRICTIONAL PRESSURE DROP IN FLOW OF LIQUID–GAS MIXTURES IN HORIZONTAL PIPES. Chawla, J. M. Translated from Forsch. Ingenieurw.; 34: No. 2, 47-54(1968). 17p. Dep. NTIS $3.00.
A generally valid relation was formulated for the frictional pressure drop in the flow of gas–liquid mixtures in horizontal pipes. Except for very high pressures and simultaneously low vapor contents, it is valid within broad ranges of important variables determining the frictional pressure drop, such as the mass flow rate, vapor content, pipe diameter, pipe roughness, and material properties of both phases in a single-component and two-component two-phase systems. The new equation allows a considerably more accurate description of the frictional pressure drop than had been possible with all calculation methods published to date. (auth)

26902 (ORNL-tr-2697) LIQUID HOLDUP IN PIPES FOR GAS-LIQUID MIXTURES IN TWO-PHASE FLOW. Chawla, J. M. Translated from Chem.-Ing.-Tech.; 41: 328-330(1969). 16p. Dep. NTIS $3.00.
Relations are presented allowing an accurate precalculation of the liquid holdup in adiabatic two-phase flow of gas–liquid mixtures in horizontal and vertical pipes. (auth)

26903 (ORNL-tr-2722) METALLURGY OF HEAT-RESISTANT ALLOYS FOR POWER ENGINEERING. Mirkin, I. L. Translated by Martha Gerrard from Metalloved. Term. Obrab. Metal.; No. 2, 2-6(1970). 14p. Dep. NTIS $3.00.
Data are given on the properties of low-alloy ferrite with additions of Cr, Mo, and W. The properties included strengthening (elongation), internal friction, plastic deformation resistance, and relaxation. (DLC)

26904 (RLO-2225-5-16) THEORETICAL STUDIES OF GENE SUBSTITUTION, GEOGRAPHIC VARIATION, AND SPECIATION. Annual Progress Report, November 1, 1972–October 31, 1973. Felsenstein, J. (Washington Univ., Seattle. Dept. of Genetics). 1973. Contract AT(45-1)-2225. 13p. Dep. NTIS $3.00.

26905 (RLO-2227-T-1-10) INTERACTION OF MATRIX-ISOLATED NiF_2 AND $NiCl_2$ WITH CO, N_2, NO AND O_2 AND OF CaF_2, CrF_2, MnF_2, CuF_2, AND ZnF_2 WITH CO IN ARGON MATRICES. Van Leirsburg, D. A.; DeKock, C. W. (Oregon State Univ., Corvallis. Dept. of Chemistry). 1973. 39p. Dep. NTIS $4.00.
Infrared spectra were observed using the matrix isolation technique. Perturbations of the frequencies of the small molecules and metal halides are tabulated. (9 figures, 5 tables, 35 references) (DLC)

26906 (RT/PROT-(73)7) ITALIAN SEISMICITY IN THE PAST CENTURIES. Iaccarino, E. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 27 Mar 1973. 10p. (In Italian). Dep. NTIS (U.S. Sales Only) $3.00.
A study on the historical Italian earthquakes of intensity between VI and XII grade of the M.M. scale was performed. Curves encompassing all isoseists from grade VIII to grade XII relative to earthquakes occurred between 1500 to 1972 have been drawn on a map of Italy. This has been done for the time intervals 1893 to 1972 and 1500 to 1972. These curves outline areas where, at least once in the time interval of interest, earthquakes of that given intensity have been recorded. The areas of the Italian municipalities which are listed in the Italian Seismic Act have been drawn on the same maps; it is interesting to remark that these areas are in good agreement with the events of the last 80 years, but the agreement is rather poor for the events of the 1500 to 1972 interval. (auth)

26907 (RT/PROT-(73)12) GENERAL CATALOGUE OF ITALIAN EARTHQUAKES. Carrozzo, M. T.; de Visintini, G.; Giorgetti, F.; Iaccarino, E. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 14 May 1973. 214p. Dep. NTIS (U. S. Sales Only) $12.75.
Main characteristics of this catalogue are: (1) the data are collected on punched cards and are available on request both on magnetic tape and on print-out; (2) the catalogue is continuously revised and kept up-to-date; (3) particular emphasis is given to macroseismic data, since microseismic information is already supplied by other specialized catalogues, such as the ISS, ISC, USCGS, BCIS, ones; and (4) one punched card is used for each earthquake, in order to reduce as much as possible the size of the catalogue; whenever further data are available, they are collected on file sheets, each one of them referring to one single earthquake. Both catalogue and file sheets are available from the Osservato rio Geofisico Sperimentale; V. le R. Gessi 4; 34123 Trieste (Italy), at the mere cost of working out the copies. If the catalogue is requested on magnetic tape, the user should note that it is produced on a CDC computer with 7- and 9-track tape units. (auth)

26908 (SC-DR-720718) TICON: THE TONOPAH TEST RANGE TIMING AND CONTROL SYSTEM. Shaum, R. L. (Sandia Labs., Tonopah, Nev. (USA)). Jun 1973. 52p. Dep. NTIS $3.00.
The TICON (TIming and CONtrol) system provides timing and control to all of the normal operating areas at TTR except for a few areas lying outside the line-of-sight from the Control Point. The system uses Inter-Range Instrumentation Group (IRIG) time-code formats for timing and synchronization of test data. The chief value of the system is that timing and controls can be locked throughout the range, achieving a degree of simultaneity in signal relaying not previously possible. (auth)

26909 (SLA-73-32) SIMULTANEOUS MEASUREMENT OF SURFACE TEMPERATURE AND SURFACE EMISSIVITY. Final Report. Wessling, F. C. Jr. (New Mexico Univ., Albuquerque. Bureau of Engineering Research). Oct 1972. Contract 51-1984-5. 64p. Dep. NTIS $5.25.
For Sandia Corp., Albuquerque, N. Mex.
A method is described and demonstrated for simultaneously de-

termining the emissivity and the surface temperature of an opaque, thermally radiating body. The method utilizes a spherical mirror to focus emitted radiation upon its point of origin; this radiation is chopped to distinguish it from the radiation directly emitted by the body and to minimize the effect of noise. The ratio of the chopped reflected signal to the directly emitted signal yields the reflectivity, and hence, emissivity. Data are presented for the emissivity of graphite in agreement with published values. (21 figures, 10 references) (auth)

26910 (SLA-73-128) LARGE-DEFLECTION ELASTIC–PLASTIC DYNAMIC RESPONSE OF STIFFENED SHELLS OF REVOLUTION. Final Report. Stricklin, J. A.; Haisler, W. E.; Von Riesemann, W. A.; Leick, R. D.; Hunsaker, B.; Saczalski, K. J. (Texas Agricultural and Mechanical Univ., College Station. Dept. of Aerospace Engineering). Dec 1972. 112p. Dep. NTIS $5.45.

This report presents the formulation and checkout problems for a computer code DYNAPLAS, which analyzes the large deflection elastic–plastic dynamic response of stiffened shells of revolution. The formulation for special discretization is by the finite-element method with finite differences being used for the evaluation of the pseudo forces due to material and geometric nonlinearities. Time integration is by the Houbolt method. The stiffeners may be due to concentrated or distributed eccentric rings and spring supports at arbitrary angles around the circumference of the elements. Checkout problems include the comparison of solutions from DYNAPLAS with experimental and other computer solutions for rings, conical and cylindrical shells, and a curved panel. A hypothetical submarine including stiffeners and missile tube is studied under a combination of hydrostatic and dynamically applied asymmetrical pressure loadings. (auth)

26911 (SLA-73-204) ATMOSPHERIC SPEED-OF-SOUND MEASUREMENT DEVICE. Galbraith, L. K. (Sandia Labs., Albuquerque, N. Mex.). Aug 1973. 28p. Dep. NTIS $4.00.

A lightweight balloon-borne gauge was developed to measure atmospheric speed of sound at altitudes between 0 and 30 km. The advantages and disadvantages of various sound-velocity measurement techniques are surveyed, and accuracy-limiting phenomena in the atmosphere and in the laboratory environment are discussed. In the gage design resulting from these studies, the sound velocity is determined from the phase difference between the signals from two sound receivers. These receivers are mounted at slightly different distances from a common transmitter emitting sound at a fixed frequency. The gage output is a pulse-width modulated signal which is sent to a modified radiosonde transmitter. Accuracies of better than 1% in the field and 0.6% in climate chambers have been demonstrated at ambient temperatures between +70 and –80°F. Inexpensive, readily available components are used in constructing the gage. (auth)

26912 (SLA-73-399) HIGH-FRAME-RATE UNDERWATER CAMERA SYSTEM. Llamas, J. S.; Thebert, J. B. (Sandia Labs., Albuquerque, N. Mex.). Jul 1973. 7p. Dep. NTIS $4.00.

This report describes the assembly and capabilities of a camera package used in an underwater instrumentation program. A high-frame-rate underwater photography system provided a photometric record of a recovery package being ejected at high velocity from a parent vehicle at an ocean depth of 1000 feet. (auth)

26913 (SLA-73-525) VIDICON DIGITIZING OF OSCILLOSCOPE TRACES. Bachand, G. R.; Evans, T. L.; Treece, R. K. (Sandia Labs., Albuquerque, N. Mex.). Sep 1973. 25p. Dep. NTIS $4.00.

A vidicon digitizing technique applicable to fast transient or repetitive waveforms was developed which can be used with any commercial oscilloscope. An effective sampling rate of 25 GHz was achieved. (auth)

26914 (SLA-73-653) DIFFRACTION OF PLANAR ELECTROMAGNETIC WAVES BY A SLOT. Jones, R. D. (Sandia Labs., Albuquerque, N. Mex.). Sep 1973. Contract AT(29-1)-789. 16p. Dep. NTIS $4.00.

Edge-wave methods are used to estimate the amplitude of electromagnetic-wave coupling through an aperture slot in a plane screen. The high-frequency approximation is used to calculate far-field values. Computed results show good agreement with experimental data. (auth)

26915 (SLA-73-689) TECHNIQUE FOR PRECISE ALIGNMENT OF A POCKELS CELL IN A Q-SWITCHED LASER CAVITY. McCarthy, A. E. (Sandia Labs., Albuquerque, N. Mex.). Aug 1973. 5p. Dep. NTIS $3.00.

Use of this technique enhances control of the lasing action in a Q-switched laser cavity, reducing the possibility of unwanted long pulse or prelasing. This technique is useful in any Pockels cell laser cavity, but is especially valuable in cavities which use only a portion of the total cross sectional area of the lasing material. (auth)

26916 (SLA-73-782) PT3064 FIRE SET SPIN TESTER. Yingst, R. B. (Sandia Labs., Albuquerque, N. Mex.). Aug 1973. 28p. Dep. NTIS $3.50.

This report covers the development of a test system for active testing of components under high-speed environments. The problems encountered and their solutions are presented. The design of the PT3064, the test flow of the PT3064, and the special instrumentation used to evaluate the centrifuge dynamic characteristics are discussed. (auth)

26917 (SLA-73-881) HIGH-ENERGY HF LASER INITIATED BY AN INTENSE ELECTRON BEAM. Patterson, E. L.; Gerber, R. A. (Sandia Labs., Albuquerque, N. Mex.). May 1973. Contract AT(29-1)-789. 12p. Dep. NTIS $3.00.

An experiment is described in which an intense electron beam, propagating in an $SF_6C_2H_6$ mixture, is used to initiate chemical reactions that produce an HF laser. The variation of laser energy as a function of the pressure of SF_6 at a fixed composition ratio and as a function of the composition ratio at a constant SF_6 pressure was investigated. The maximum laser energy was ≈200 J and was obtained with a mixture of 400-torr SF_6 and 40-torr C_2H_6. The efficiency for converting deposited electron-beam energy to laser energy was as large as 8%. (auth)

26918 (SLA-73-5390) EXPERIMENTAL INVESTIGATION OF CAPTIVE FLIGHT LOADS ON A BOMB DURING EXTERNAL CARRIAGE ON THE F-111 AIRCRAFT. Meyer, S. D.; Sisson, C. E. (Sandia Labs., Albuquerque, N. Mex.). [nd]. 41p. (CONF-730925-1). Dep. NTIS $4.25.

From 2nd JTCF/ALNNO aircraft/stores compatibility symposium, Sacramento, California, USA (18 Sep 1973).

In the mid-1960's structural-loads analyses of externally carried bombs indicated that additional information was needed to: (1) verify the adequacy of wind-tunnel data in predicting bomb carriage loads and (2) adequately define the distribution of aerodynamic loads on the various bomb components (nose, fins, etc.). Sandia Laboratories has designed and flown a B43 FLU (Flight Loads Unit) in an attempt to better define bomb-carriage loads by obtaining full-scale flight data. This unit includes instrumentation to measure aerodynamic load distributions in addition to the total aerodynamic forces and moments. The B43 FLU was carried on numerous F-111 flights during the aircraft Category I structural verification program at Edwards AFB during 1971 and 1972. Data collected included the FLU data (pressures, forces, strains, and accelerations) and aircraft flight parameters. This paper discusses the design of the B43 FLU including techniques involved in the calibration. Procedures employed in determining the bomb aerodynamic force and moment coefficients and the calculation of estimates of aerodynamic forces on the bomb nose, fins, and tail are described. Comparisons are made between aerodynamic coefficients calculated from the B43 FLU and those obtained from wind-tunnel tests. Some preliminary results of indicated airload distributions are also discussed. (auth)

26919 (SRO-641-9) POPULATION ENERGETICS AND ECOLOGY OF THE ROCK GRASSHOPPER, TRIMEROTROPIS SAXATILIS. Duke, K. M. (Georgia Univ., Athens. Dept. of Entomology). 1973. 52p. Dep. NTIS $4.75.

26920 (SRO-641-10) METHOD FOR QUANTIFYING PITFALL TRAPPING. Gist, C. S.; Crossley, D. A. Jr. (Georgia Univ., Athens). 1973. 12p. Dep. NTIS $3.00.

A method is described for estimating population sizes of arthropods inhabiting the soil surface, using pitfall trapping procedures. The problem of migrations was circumvented by using aluminum foil strips, coated with resin, as barriers around plots. Estimates of populations of Diplopoda, Araneida, Orthoptera, and Coleoptera made with the pitfall technique showed good agreement with estimates based on hand sorting. (auth)

26921 (SRO-641-11) LITTER ARTHROPOD COMMUNITY IN A SOUTHERN APPALACHIAN HARDWOOD FOREST: NUMBERS, BIOMASS, AND MINERAL ELEMENT CONTENT. Gist, C. S.; Crossley, D. A. Jr. (Georgia Univ., Athens). 1973. Contract AT(38-1)-641. 36p. Dep. NTIS $4.00.

26922 (SRO-641-12) SYSTEMS MODEL OF CALCIUM DYNAMICS IN A PINE LITTER COMMUNITY. Cornaby, B. W.; Vyas, A. B.; Garten, C.; Embry, R. (Georgia Univ., Athens. Inst. of Ecology). 1972. 21p. Dep. NTIS $3.25.

A systems model is developed for the litter subsystem on the forest floor of a white pine plantation. The paper also describes specific steps for simulating the behavior of calcium in the system under selected experimental conditions. (auth)

26923 (TID-26434) NUCLEIC ACIDS AND PROTEIN SYNTHESIZING MECHANISMS IN MITOCHONDRIA. Progress Report. Suyama, Y. (Pennsylvania Univ., Philadelphia. Dept. of Biology). 1973. Contract AT(11-1)-3083-3. 5p. Dep. NTIS $3.00.

26924 (UCID-16261) HIGH-PRESSURE MECHANICAL PROPERTIES OF MT. HELEN, NEVADA, TUFF. Heard, H. C.; Bonner, B. P.; Duba, A. G.; Schock, R. N.; Stephens, D. R. (California Univ., Livermore. Lawrence Livermore Lab.). 22 May 1973. Contract W-7405-Eng-48. 41p. Dep. NTIS $4.25.

Pressure–volume, uniaxial stress, failure envelope, uniaxial strain, and acoustic velocity measurements were made on the porous, fine-grained Mt. Helen tuff at three levels of saturation: 0, 50, and 100%. (auth)

26925 (UCID-16270) ON THE EXISTENCE OF SOLITON SOLUTIONS. Glass, A. J. (California Univ., Livermore. Lawrence Livermore Lab.). 1 May 1973. Contract W-7405-eng-48. 9p. Dep. NTIS $3.00.

Recently, A. Hasegawa and F. Tappert (Bell Lab. preprint) have described the propagation of stationary light pulses in dispersive optical fibers exhibiting refractive index nonlinearity, in terms of "soliton" solutions. In this note, it is shown that their solutions can be obtained by elementary means from the "fluid-mechanical" form of the light propagation equation; and that the special properties of the solutions are readily related to the boundary conditions imposed on that equation. (auth)

26926 (UCID-16276) INITIAL PERFORMANCE TEST OF THE LLL INFRARED CIRCULAR STREAK CAMERA TUBE. Kalibjian, R. (California Univ., Livermore. Lawrence Livermore Lab.). 7 May 1973. Contract W-7405-eng-48. 11p. Dep. NTIS $3.00.

26927 (UCLA-12-919, pp 4-6) LIPID METABOLISM IN BRAIN AND MEMBRANES IN DEVELOPMENT AND AGING. 1973.

In annual progress report for the period ending June 30, 1973.

26928 (UCLA-12-919, pp 6-9) CONTROL OF LIPID METABOLISM IN BACILLI. 1973.

In annual progress report for the period ending June 30, 1973.

26929 (UCLA-12-919, pp 9-11) LIPID COMPOSITION, FUNCTION, AND METABOLISM IN MARINE ORGANISMS. 1973.

In annual progress report for the period ending June 30, 1973.

26930 (UCLA-12-919, pp 17-20) ENZYME INDUCTION AND CONTROL BY HORMONAL AND SERUM FACTOR. 1973.

In annual progress report for the period ending June 30, 1973.

26931 (UCLA-12-919, pp 21-23) ORGAN SPECIFIC PROTEIN SYNTHESIS. 1973.

In annual progress report for the period ending June 30, 1973.

26932 (UCLA-12-919, pp 23-25) CHARACTERIZATIONS OF CELLS IN CULTURE. 1973.

In annual progress report for the period ending June 30, 1973.

26933 (UCLA-12-919, pp 25-26) MEMBRANE FUNCTIONS. 1973.

In annual progress report for the period ending June 30, 1973.

26934 (UCLA-12-919, pp 52-53) SOIL FACTORS. 1973.
In annual progress report for the period ending June 30, 1973.

26935 (UCLA-12-919, pp 53) SPECTROSCOPY. 1973.
In annual progress report for the period ending June 30, 1973.

26936 (UCRL-13580) EQUATION OF STATE OF ROCKS. Final Report, April 1, 1972–March 31, 1973. Murri, W. J.; Grady, D. E. (Stanford Research Inst., Menlo Park, Calif.). Apr 1973. Contract AT(04-3)-115. 35p. Dep. NTIS $3.75.

For Univ. of California, Livermore.

Shock wave loading and release wave paths were measured for Arkansas novaculite (a polycrystalline quartz rock), Nugget sandstone, Blair dolomite, dry and water-saturated NTS tuff, and dry Indiana limestone. (40 figures, 37 references) (auth)

26937 (UCRL-51130(Vol. 4)) FINAL REPORT ON THE DEVELOPMENT OF THE GEOGRAPHIC POSITION LOCATOR (GPL). Volume 4. Error Reduction. Radewan, C. H. (California Univ., Livermore. Lawrence Livermore Lab.). 25 May 1973. Contract W-7405-eng-48. 83p. Dep. NTIS $5.45.

This report discusses error reduction techniques that can be used in conjunction with the inertial navigator in the Geographic Position Locator (GPL) system. Only techniques that use no external navigation aids are considered. When the inertial platform is at rest with respect to the earth, measurements obtained from various platform error rates can be used to determine portions of the navigator position errors and gyro drift rates. These self-calibration techniques allow an inertial navigation system (INS) to operate unattended for several days with relatively low position errors. The primary techniques of interest are classical damping methods, Kalman filtering, and a combination of these. This report also discusses how two techniques, a full Kalman filter and a reduced state Kalman filter with platform damping, were implemented on the GPL-A test system. (auth)

26938 (UCRL-51405(Rev. 1)) AQUATIC AND ATMOSPHERIC SIMULATION. Knox, J. B.; Hardy, D. M.; Sherman, C. A. (California Univ., Livermore. Lawrence Livermore Lab.). 18 Jun 1973. Contract W-7405-Eng-48. 12p. Dep. NTIS $4.00.

Several numerical models have been developed for atmospheric studies. These models contain methods of solution that are transferable to significant unsolved problems in water pollution. This transferable experience is discussed and illustrated in terms of regional scale sediment transport problems. (auth)

26939 (UCRL-Trans-1498) STUDY OF THE DISTRIBUTION OF POTENTIAL ON THE SURFACE OF A RING-DISK ELECTRODE. Gabrielli, C.; Keddam, M.; Takenouti, H. Translated by C. M. Mohr, Jr. from J. Chim. Phys.; 69: 739-740(1972). 9p. Dep. NTIS $3.00.

An experimental study was made of the potential distribution on the surface of a rotating-disk electrode, using the anodic dissolution of Fe in sulfuric acid, for the two cases of ohmic coupling and current distribution. (DLC)

26940 (UCRL-Trans-1499) ATOMIC ABSORPTION SPECTROMETRIC DETERMINATION OF CADMIUM IN SERUM AND URINE. Lehnert, G.; Schaller, K. H.; Haas, T. Translated from Z. Klin. Chem. Klin. Biochem.; 6: No. 3, 174-176(1968). 5p. Dep. NTIS $3.00.

26941 (UR-3490-141) MOLECULAR BIOLOGY OF MYCOPLASMA VIRUSES. Maniloff, J.; Liss, A. (Rochester Univ., N. Y. Dept. of Radiation Biology and Biophysics). [nd]. 17p. (CONF-730129-1). Dep. NTIS $3.00.

From conference on mycoplasmas; New York, New York, USA (Jan 1973).

26942 (UR-3490-142) BIOSYNTHESIS AND SUBCELLULAR ORGANIZATION OF NUCLEIC ACIDS IN MYCOPLASMA GALLISEPTICUM A5969. Maniloff, J.; Quinlan, D. C. (Rochester Univ., N. Y. Dept. of Radiation Biology and Biophysics). [nd]. 19p. (CONF-730129-2). Dep. NTIS $3.00.

From conference on mycoplasmas; New York, New York, USA (Jan 1973).

The data show that, in M. gallisepticum A5969, there is a membrane associated DNA replication site that can be isolated. It is sensitive to the action of detergents, DNase and pronase; but it is resistant to saponin, RNase, and phospholipase-C. The replication complex is found in the same subcellular fraction as the bleb structures and it seems most probable that these structures are the sites of DNA synthesis. The cell replicates its chromosome discontinuously, stopping DNA synthesis during cell division, and one round of DNA replication occurs per cell generation. The DNA region synthesized at the start of the cell cycle appears to be permanently associated with the membrane-bleb structures. (auth)

26943 (UR-3490-349) LINE-BROADENING EFFECT OF MANGANOUS IONS AND OF CUPRIC IONS ON THE PROTON MAGNETIC RESONANCE SPECTRA OF ADENINE NUCLEOTIDES. Wee, V. T. (Rochester Univ., N. Y. Dept. of Radiation Biology and Biophysics). 1973. 103p. Dep. NTIS $7.25.

Thesis.

26944 (WASH-1255) STUDY OF VERTICAL AND HORIZONTAL EARTHQUAKE SPECTRA. (Newmark (Nathan M.) Consulting Engineering Services, Urbana, Ill. (USA)). Apr 1973. Contract AT(49-5)-2667. 153p. GPO $2.10.

The object of the study (a) Develop vertical and horizontal (two components) response spectra for a series of 14 strong motion earthquake records, including four San Fernando records, over the range of frequencies of interest, for 0.5, 2, 5 and 10% of critical damping. The records included as a part of the study are described. (b) Compare the vertical and horizontal responses obtained from these spectra. (c) Determine the shape of the spectra in the high frequency range from 6 to 50 hertz, with special emphasis on site-dependent parametric effects. (d) Suggest procedures for combining seismic stresses derived from horizontal and vertical responses. (e) Summarize the above-noted studies in the light of recommendations for design. (auth)

26945 (Y-1890) CARBON MICROSPHEROIDS AS EXTINGUISHING AGENTS FOR METAL FIRES. Schmitt, C. R. (Oak Ridge Y-12 Plant, Tenn. (USA)). 28 Aug 1973. Contract W-7405-eng-26. 23p. Dep. NTIS $4.00.

Laboratory-prepared and commercially procured carbon microspheroids, having a particle diameter of approximately 100 to 500 μ, were characterized analytically and evaluated for their effectiveness as extinguishing agents for metal fires. Their excellent flow

and transport properties through a nozzle, high termal conductivity, chemical inertness, low density, and absence of dusting make them more advantageous than graphite flour or commercial chloride and phosphate powders for extinguishing metal fires. (auth)

26946 ERG PROCESSING SYSTEM FROM GEPP (18 Dec 1972) (ENGINEERING MATERIALS). (General Electric Co., St. Petersburg, Fla. Neutron Devices Dept.). (CAPE-2359).

112 drawings.

The SE1013 ERG test system is an integration of two systems to process and test the extended range gap (ERG). The ERG is a wide-voltage-range, 10-kV spark gap. The development of the tester portion of the SE1013 is described. (auth)

26947 LASER-INITIATED SWITCH (7 Jun 1972) (ENGINEERING MATERIALS). (General Electric Co., St. Petersburg, Fla. Neutron Devices Dept.). (CAPE-2353).

14 drawings.

A high-vacuum laser-initiated switch was developed for "crowbar" applications to supply a fast fall pulse over a pulsed voltage range of 50 to 200 kilovolts. The switch was tested and demonstrated short circuit current capability of 300 amperes. (auth)

26948 VISTA SYSTEM (ENGINEERING MATERIALS). (Chicago Operations Office (AEC), Ill.). (CAPE-2346).

16 drawings.

VISTA, the Variable Interlace System for Television Applications system, is a system that compresses the bandwidth of a television signal according to the rate of change of information that it is carrying. The system determines automatically the amount of information that has changed since the previous sampling period and selects one of sixty-four possible scanning rates commensurate with this change. (See also COO-1469-0207). (auth)

26949 DIAL INDICATOR TIP RETRACTING AND LOCKING DEVICE (ENGINEERING MATERIALS). (Union Carbide Corp., Oak Ridge, Tenn. Y-12 Plant). (CAPE-2357).

1 drawing.

A device is described which, when attached to the body of a dial indicator in place of the dust cap, will permit the indicator tip to be held in a retracted position indefinitely. The compact size and shape allows grouping of several indicators close together or in small spaces, with no danger of the tips being released accidentally while a part is being loaded or unloaded. (auth)

26950 ULTRASONIC TELEMETRY SYSTEM: FISH TAG II (ENGINEERING MATERIALS). (Oak Ridge National Lab., Tenn.). (CAPE-2330).

23 drawings.

A temperature-sensitive implantable fish tag was developed with the thermistor located at the end of a flexible appendage. The thermistor can be implanted with the transmitter to measure body temperature or brought outside the fish to measure water temperature. The tags transmit acoustic energy at frequencies between 65 and 100 kHz, and are pulse-period modulated by a single-capacitor complimentary multivibrator which is well compensated for changes in battery voltage. The use of a breadboard type monolithic integrated circuit allows considerable circuit sophistication in a small space and aids in reducing assembly cost. The entire assembly is covered with silicone rubber to ensure biological compatibility and the battery is easily replaceable. When equipped with a two cell battery, the useful life is 4 months and the effective range extends to 500 yards. The calibration accuracy is within ±0.2°C over a +5 to +35°C range and is maintained throughout the battery life. The overall dimensions of 32 × 17 mm (for a 2-cell battery excluding thermistor) make the tag suitable for use in fish as small as 1 pound. The received signal is easily decoded using commercially available gear by interfacing the receiver output with a frequency counter to measure the pulse period. Provisions are included for storing the pulse periods on punched paper tape for later conversion to temperature by a digital computer. (auth)

26951 SUSAN PROJECTILE (6 MAY 1966) (ENGINEERING MATERIALS). (California Univ., Livermore. Lawrence Livermore Lab.). (CAPE-2354).

7 drawings.

The attached engineering drawings of the SUSAN Mod. 1 Projectile is used by LLL to study the impact safety of explosives. The SUSAN TEST is the name applied to the tests to determine the impact sensitivity of high explosives. (auth)

26952 ULTRASONIC DRAWINGS ON TIMING AND GATING CARDS (21 OCT 1971). (Engineering Materials). (California Univ., Livermore. Lawrence Livermore Lab.). (CAPE-2360).

52 drawings.

26953 MINING YEAR BOOK, 1973. Papers Presented at the National Western Mining Conference and Exhibition, Denver, Colorado, February 8–10, 1973. Denver, Colorado Mining Association (1973). 108p. (Conf 730219–). $5.00.

Eighteen papers were presented. A separate abstract was prepared for one paper on coal gasification. The remaining 17 papers on mines, mining practices, and the environmental impact of mining practices are not within the scope of NSA. (LCL)

For an abstract of an individual paper see: 26799.

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